Founded in 1832

RAILWAY LOCOMOTIVES AND CARS

MAY 1954

FOR OFFICERS AND SUPERVISORS RESPONSIBLE FOR DESIGN, CONSTRUCTION AND MAINTENANCE OF MOTIVE POWER AND ROLLING STOCK

formerly Railway Mechanical and Electrical Engineer

BUFFALO BRAKE BEAM COMPANY

proudly announces

TWO NEW TRUSLOCK IMPROVEMENTS

TRUSLOCK NOW OFFERS 3 PREMIUM FEATURES

never before available in a single freight car brake beam.

QUICK CHANGE BRAKE HEAD

This basic feature, available only in Truslock, has already demonstrated its worth during the past three years.

* BUILT-IN CAMBER GAUGE

A 3-point visual line-up now permits carmen and inspectors to accurately check camber when inspecting brake beams at the car.

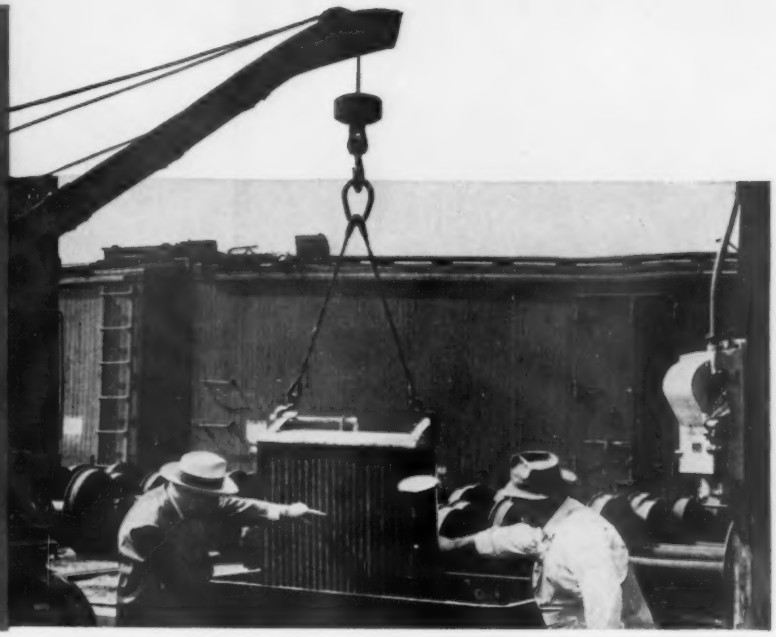
BUILT-IN SUPPORT CHAIR

Truslock's new support chair is integrally cast on the strut. Now, a single type brake beam in stock takes care of every maintenance requirement, thus reducing inventories.

* Instruction bulletins covering Truslock's Visual Camber Control are now available for distribution at all your interchange and servicing points.

Write **Buffalo Brake Beam Company**
140 Cedar Street, New York 6, N. Y.

Hot Days Ahead!



. . . Now's the time to ready your air-conditioning units for trouble-free performance.

BEFORE we know it the stifling heat of summer will be upon us. Railroad's perennial problem of passenger comfort must be shouldered and successfully solved.

Good reason, therefore, to make your move NOW toward putting your air-conditioning units in mint condition for peak summer performance.

One of your toughest air-conditioning maintenance jobs is the exterior cleaning of under-car condenser cooling units. Come springtime the fins of these cooler coils are thoroughly clogged with all manner of soils, greases, cinders, other extraneous matter that seriously impair heat transfer efficiency.

Why not let Oakite solve this "toughie" for you? Set up a speedy, economical system of energetic washing with well-agitated solution of heavy-duty Oakite cleaning compound?

free booklet . . .

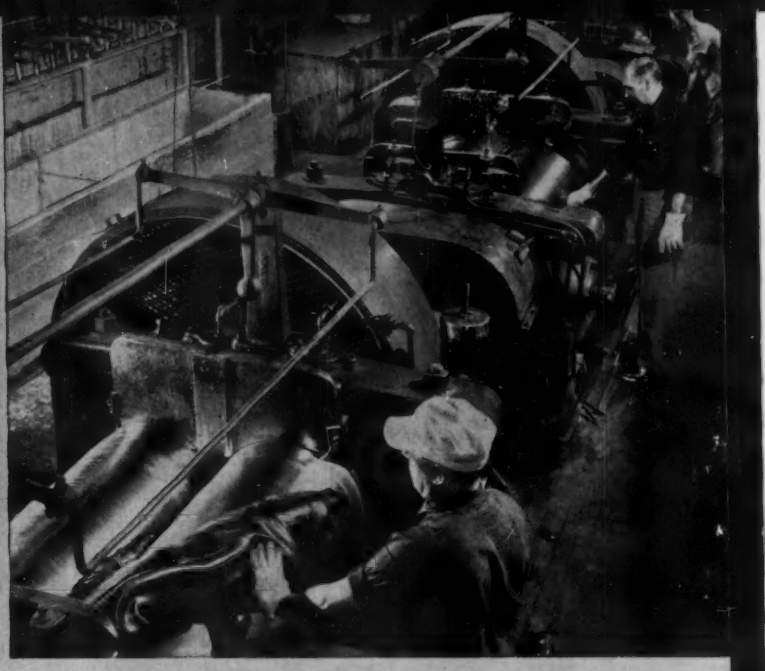
describes tank and steam-gun methods of cleaning under-car condenser cooling units plus many other air conditioning maintenance jobs including the cleaning of overhead evaporative cooling coils; mass production tank-cleaning of panel type filters; descaling evaporators, etc. You can get your copy simply by writing address below. No obligation.

OAKITE PRODUCTS, INC., 46 Rector Street, NEW YORK 6, N. Y.
In Canada: Oakite Products of Canada, Ltd. 65 Front St. East, Toronto, Ont.

OAKITE

RAILWAY DIVISION

PERFORMANCE CHARACTERISTICS of thousands of WABCO compositions are on record in our research laboratory. Here, a WABCO sample is being processed on a special laboratory mill.



ON THESE PRODUCTION MILLS, the laboratory formulas are carefully duplicated to insure that you get the proper composition every time you order genuine WABCO parts.

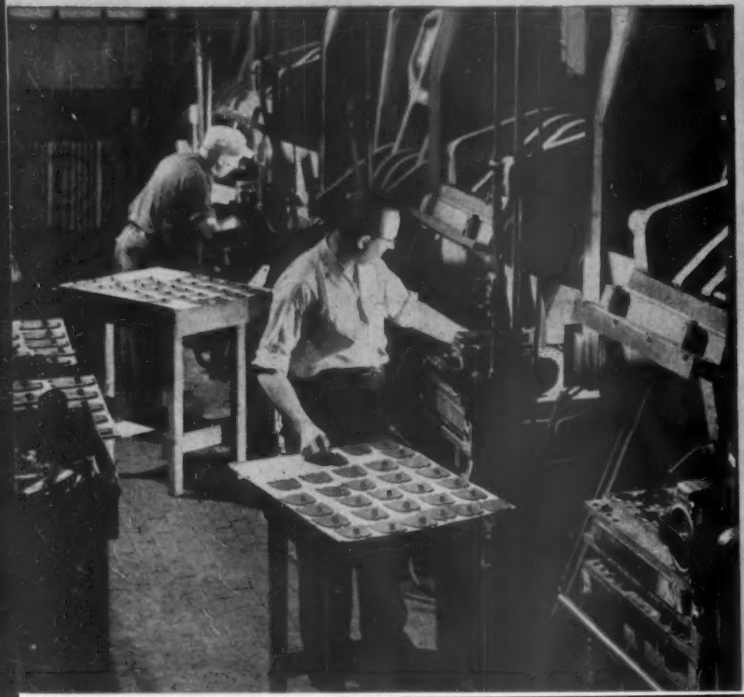
REDUCE YOUR BRAKE MAINTENANCE COSTS WITH GENUINE WABCO® PARTS

WHEN Westinghouse Air Brake puts a brake device on the market, the research doesn't stop.

Continuously thereafter field reports are reviewed and every effort is made to improve not only the functioning of the device as a whole but the component parts as well. In the case of WABCO products the many compounds are constantly being analyzed with the view toward extending service life.

Westinghouse Air Brake
COMPANY
AIR BRAKE DIVISION WILMERDING, PA.

TO MAKE THE VALVE DIAPHRAGMS shown here, two compounds of *different* characteristics are vulcanized together. No matter how *tough* the production problem, WABCO parts are designed to give maximum service.



WABCO PARTS are 100% inspected—each piece is individually checked. The WABCO reputation is upheld by the fact that we completely reject any piece that has the slightest irregularity. The result—WABCO products of uniformly high quality.

May, 1954

VOLUME 128

No. 5

RAILWAY LOCOMOTIVES AND CARS

Founded in 1832 as the American Rail-Road Journal.

Published monthly by Simmons-Boardman Publishing Corporation at 1309 Noble St., Philadelphia, Pa. Entered as second-class matter, January 16, 1953, at the Post Office at Philadelphia, Pa., under the act of March 3, 1879. Subscription price to railroad employees only in U. S., U. S. possessions and Canada, $2 one year, $3 two years, payable in advance and postage free. Subscription price to railroad employees elsewhere in the Western Hemisphere, $5 one year, $10 two years. All other countries: $7 one year, $14 two years. Single copies 50¢. Address correspondence concerning subscriptions to Robert G. Lewis, Vice-Pres. and Dir. of Circulation, 30 Church Street, New York 7.

Editorial and Executive Offices: 30 Church street, New York 7 and 79 W. Monroe street, Chicago 3. Branch offices: Terminal Tower, Cleveland 13; 1081 National Press bldg., Washington 4, D.C.; Terminal Sales bldg., Portland 5, Ore.; 1127 Wilshire blvd., Los Angeles 17, Cal.; 244 California St., San Francisco, Cal.; 2909 Maple avenue, Dallas 4, Tex.

Railway Locomotives and Cars is a member of the Associated Business Papers (A.B.P.) and the Audit Bureau of Circulation (A.B.C.) and is indexed by the Industrial Arts Index and also by the Engineering Index Service. Printed in U.S.A.

PRINTED BY PERIODICAL PRESS CORP., PHILA. 23, PA.

Best-Known "LIDS" in the business!

Like the engineer's cap, the Alcolid journal box lid is known wherever rolling stock rolls . . .

Known for ruggedness—the lid body is of 5/32 in. full section steel; hood 3/16 in. and strap 7/32 in. steel

Known for solid, simple design—only two parts: a heavy steel lid, and a square-headed retaining pin that won't rotate. won't elongate pin holes

Known for tight closure—fully articulated lid operates on sturdy torsion spring that maintains constant 50-lb pressure for permanent locking

Known for easy opening—roller is mounted on the spring to give smooth roller-bearing action—even after years of use

Known for speedy installation—one minute does it—just three simple steps —and it's set for a lifetime

Your Alco sales representative will be glad to give you full information.

ALCOLID®

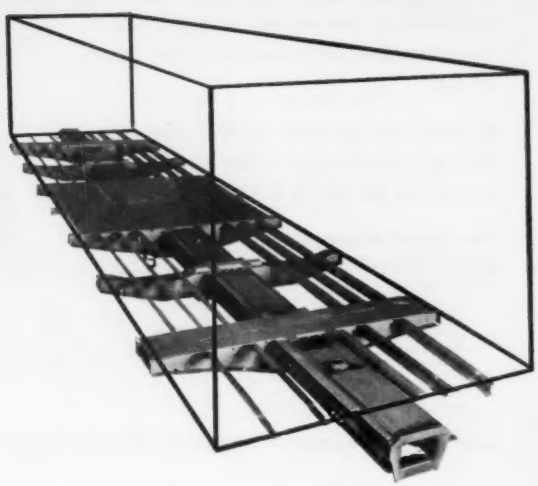
AMERICAN LOCOMOTIVE COMPANY

Sales and Service Offices in Principal Cities

new weapons in the

This is the location of the Cushion Underframe

Actually built-in as an integral part of the box car underframe, the Cushion Underframe, while inconspicuous, is intended to perform important damage reduction functions. Eight railroads using a total of 100 PS Cushion Underframes include: Bangor & Aroostook, Chesapeake & Ohio, Erie, Great Northern, New York Central, Norfolk & Western, Pennsylvania, and Western Pacific.



war against damage

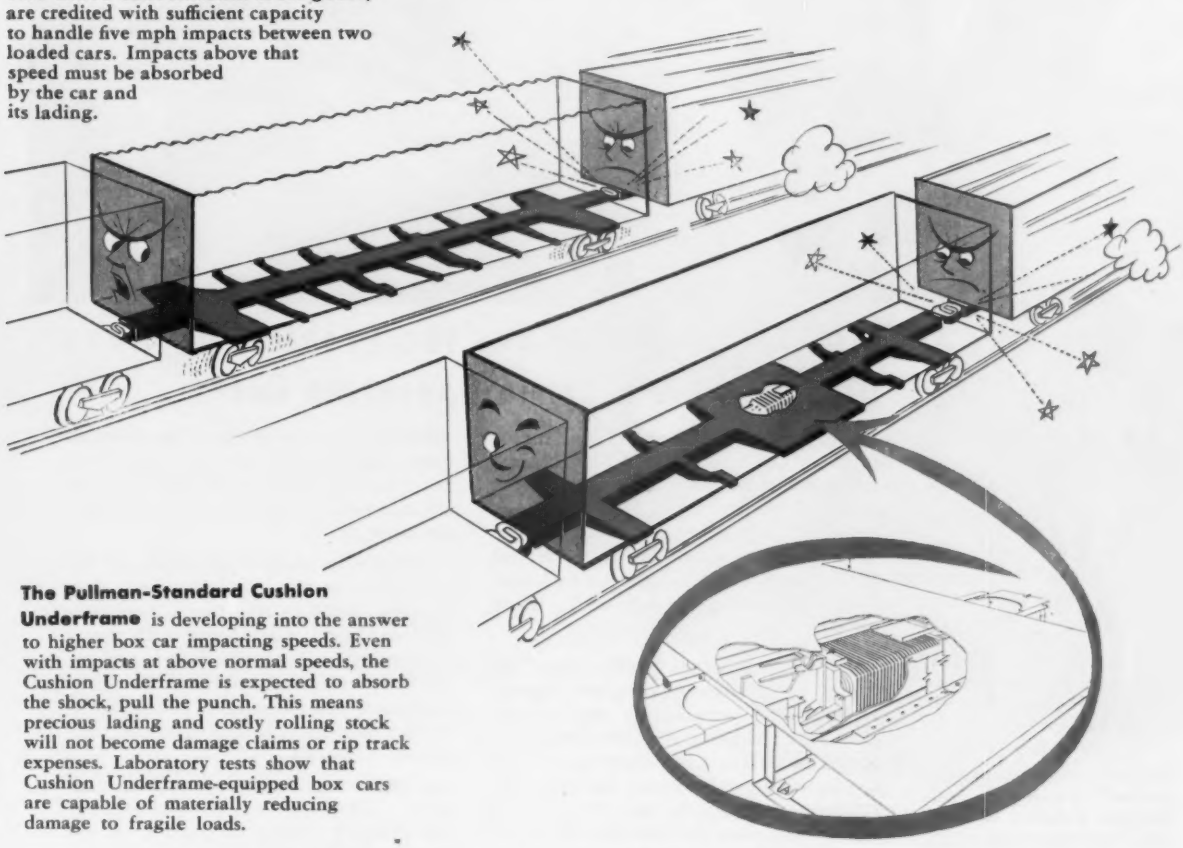
You can't see it because it's built right into the underframe of a box car. But the Pullman-Standard Cushion Underframe promises to become a new weapon in the war against lading damage. 100 Cushion Underframe-equipped PS-1 Box Cars have recently been put into service on eight railroads, in another attack on costs of lading damage.

Pullman-Standard engineers and researchers, joining forces with the railroads, continue to search for new damage prevention developments. In addition to important advances expected from the Cushion Underframe, significant damage reduction progress is being evidenced by the PS Box Car Compartmentizer and the full length Lading Strap Anchor.

Such lading protection devices as these are continuing to help railroads to offer faster service for shippers. And consignees are able to count more and more on receiving their shipments on time, with less and less damage. Three informative books detailing the Cushion Underframe, the Compartmentizer, and the Lading Strap Anchor have been prepared by Pullman-Standard. Write for your copies.

A CLUE TO BETTER LADING PROTECTION

Two active conventional draft gears, are credited with sufficient capacity to handle five mph impacts between two loaded cars. Impacts above that speed must be absorbed by the car and its lading.



The Pullman-Standard Cushion Underframe is developing into the answer to higher box car impacting speeds. Even with impacts at above normal speeds, the Cushion Underframe is expected to absorb the shock, pull the punch. This means precious lading and costly rolling stock will not become damage claims or rip track expenses. Laboratory tests show that Cushion Underframe-equipped box cars are capable of materially reducing damage to fragile loads.

YOUR NEEDS CREATE THE PULLMAN "STANDARD"

PULLMAN-STANDARD

CAR MANUFACTURING COMPANY

SUBSIDIARY OF PULLMAN INCORPORATED

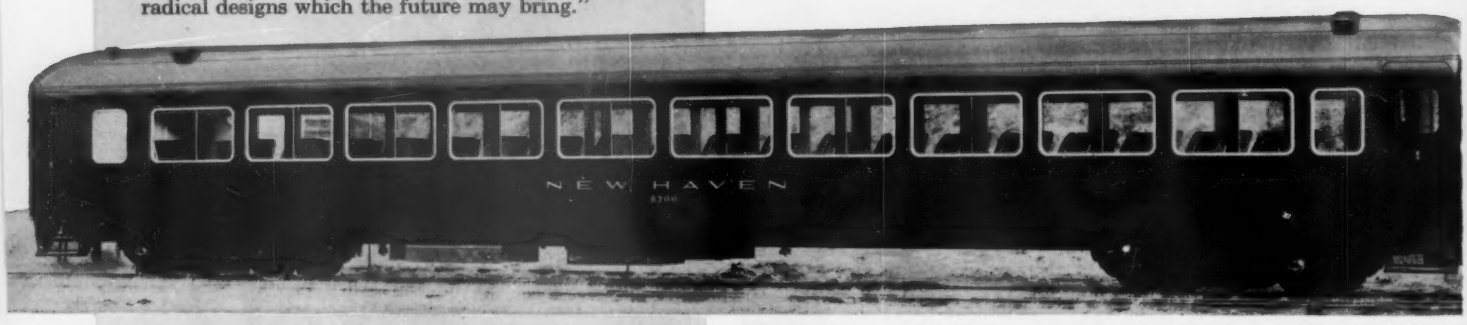
79 EAST ADAMS STREET, CHICAGO 3, ILLINOIS

BIRMINGHAM, PITTSBURGH, NEW YORK, SAN FRANCISCO WASHINGTON

6,000 passenger cars have been built

THE "NEW LOOK" IN PASSENGER COACHES IN 1934

Fresh from the Worcester shops of Pullman Standard Car Mfg. Co., this coach is the first of 50 streamlined passenger cars built for the New York, New Haven and Hartford Railroad Company over 19 years ago. Describing this equipment, RAILWAY AGE in its Jan. 5, 1935 issue says, "Built to provide the maximum in comfort with an improved appearance, it represents a pleasing transition from the conventional in railroad passenger equipment to the more radical designs which the future may bring."



STILL "NEW LOOKING" AFTER 19 YEARS OF SERVICE

From its appearance today it is hard to realize that this New Haven car, like the others built in 1934, has been in operation for almost two decades. Its present excellent condition is primarily due to forward-looking engineering both in design and construction and to the choice of materials well able to meet service requirements. Still thoroughly modern, it shows both inside and out the remarkable ability of lightweight COR-TEN steel equipment to stay in revenue-producing service year after year.

better with USS COR-TEN steel since 1933

The New Haven's first streamlined coaches

in service since 1934

prove the durability of lightweight construction with USS COR-TEN High Strength Steel

PASSENGERS on the New Haven opened their eyes in amazement when they stepped into these cars almost twenty years ago. For here was something entirely new and different in coach service. Sleek streamlined exteriors. Attractively decorated interiors. Improved lighting. Extra wide windows. Air conditioning. Individual seating. Here for the first time was superior traveling comfort at coach fare rates.

And for the railroad company, here were 50 cars weighing only 107,500 lbs. each—38,500 lbs. less per car than conventional equipment would have weighed. In addition, these cars were able to carry as many passengers as 50 old-style cars with no more power than was required to haul 37 conventional units.

The original 50 New Haven streamlined coaches were quickly followed by 100 more. By 1938, 205 units of like design and construction had been put into service. After the war, the New Haven ordered additional cars including diners, grill and parlor-observation cars so that today they have 385 of these COR-TEN-built units in service.

All of this equipment has been periodically shopped on a four-year basis. And speaking particularly of the cars built up to 1938, the New Haven's General Mechanical Superintendent says, "A close inspection has been made of the COR-TEN steel construction and—aside from defects which can be attributed to wear and tear—we have found the material to be in satisfactory condition. COR-TEN steel in general has given very good service."

• • • •

What is especially significant in this report is the fact that in these cars, which are up to 26.3% lighter than conventional design, body weight has been reduced from 54,700 lbs. to 29,600 lbs. by using USS COR-TEN steel in one-half the thicknesses required by conventional material.

USS COR-TEN steel is now used in more than 6000 cars to reduce weight and ensure safety, durability and operating economies

The universally good performance of USS COR-TEN steel in early applications like the New Haven cars is only one reason why this superior structural steel is so widely used today in equipment that ranks as the most modern, efficient and also as the most profitable to operate. For not only does USS COR-TEN steel provide high strength and superior resistance to atmospheric corrosion but it lends itself readily to advanced fabrication techniques. In addition the cost of USS COR-TEN steel is comparatively low.

Over twenty years' experience in helping car builders and railways apply USS COR-TEN steel in passenger car units of every type, as well as in more than 180,000 freight cars of all kinds, has given us a background of practical knowledge which is freely placed at your disposal.

UNITED STATES STEEL CORPORATION, PITTSBURGH • AMERICAN STEEL & WIRE DIVISION, CLEVELAND • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
NATIONAL TUBE DIVISION, PITTSBURGH • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

UNITED STATES STEEL

One type of General Electric cable is used for the traction motor leads shown here, as well as for other power circuits, and, in smaller sizes and lower voltage rating, for control circuits.

You need just one type of G-E cable

for your diesel-electric locomotive rewiring program

One type of G-E diesel-electric locomotive cable can be used *size for size* to replace the worn-out general-purpose wiring in any locomotive. This cable is General Electric Versatol* Geoprene. It is available in sizes No. 14 Awg and larger with a 1000-volt rating for power circuits, and in sizes No. 16 and 14 Awg with a 300-volt rating for control circuits. The rating of the control cable is printed on the insulation for easy identification.

Versatol Geoprene cable has the toughness needed for power circuits

The neoprene-base jacket protects against flying dust, grit, and sand. It resists oils, water, cleaning compounds, live steam, and ice. The extra-flexible rope stranding is designed to withstand continual flexing. The insulation has excellent heat and moisture resistance to withstand severe operating conditions.

Versatol Geoprene has the easy-handling properties needed for control circuits

Fine stranding makes this cable flexible and easy to pull. The insulation strips cleanly for easy application of terminals. Uniform diameters simplify installation.

Simplify your stocking problems

Use this one type of G-E cable for all general-purpose rewiring. Special high-temperature cables are available for use in high heat areas. For more information, write Section W118-547, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

*Registered Trade-mark General Electric Company

You can put your confidence in—

GENERAL ELECTRIC

Major Railroad specifies on 63 New Light

Designs and engineers a new truck to take full advantage of the great

The Problem:

Past successful experience with Dayton Endless V-Belts on car-lighting generators indicated that they be specified for 63 new "Budd-built" baggage-express cars.

Knowing full well the cost of car-lighting failures in battery recharging, down-time and lost working hours for the express crew, the decision to make Dayton Endless drives a component part was basic.

Also important was the requirement that installation and servicing of the drives be reduced to an absolute minimum. Of further major consideration on these NEW cars was the possibility of redesigning the end sill to eliminate cutting and splicing.

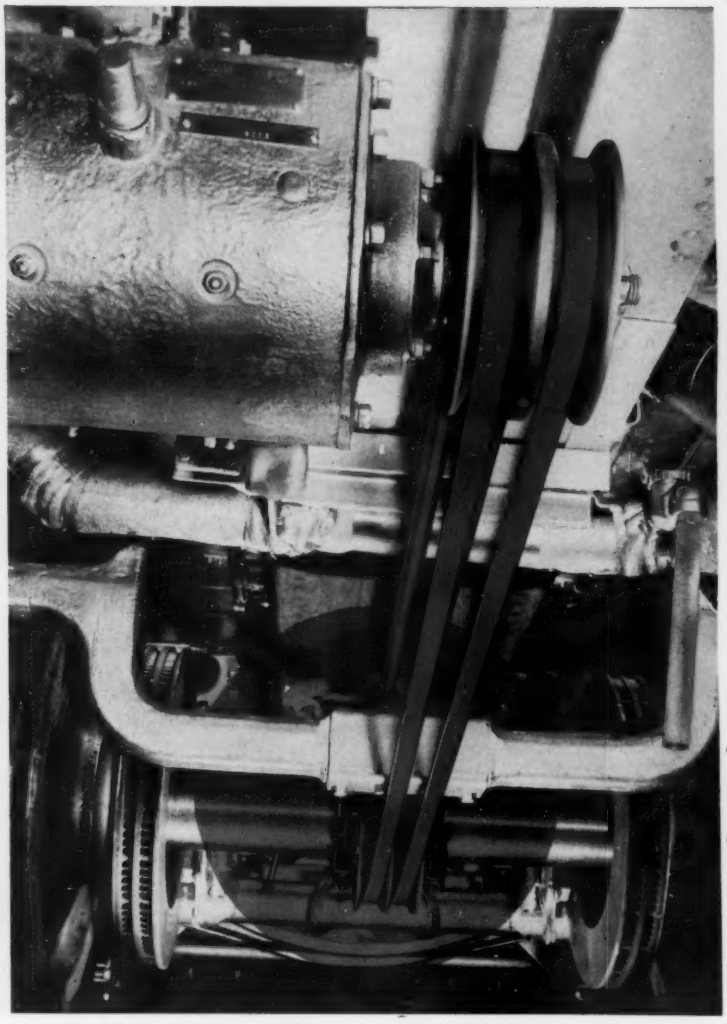
While the cars were in the design stage, it was decided to make these additions or changes that would accomplish the two objectives—guaranteed full-power lighting and easy access to the V-Belt Drives.

The Solution:

The railroad, one of the nation's most progressive, went all-out in achieving the desired results. First, in cooperation with Dayton Railway Field Engineers, it was determined that two Dayton Endless V-Belts would supply more than adequate power for all car-lighting generators on the new baggage-express cars. These were specified and subsequently applied.

Secondly, the railroad's own Mechanical Engineers designed a new truck for the cars that would accommodate the Dayton Endless axle drives without having to handle an end-sill splice for belt replacement.

The newly designed trucks, shown at right, were found to have equal or greater strength than conventional type end-sills in every test. This is another typical example of how Dayton Rubber Company's Field Engineers and Railway Engineers work together to improve railway service across the country.

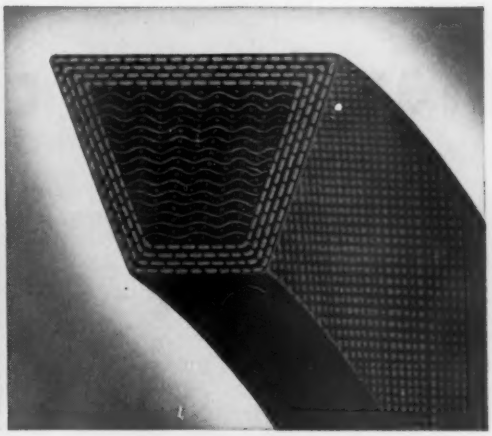


New End-Sill Design offers "quick-change" features.

Specially designed for use with Dayton Endless V-Belts, this end-sill has a raised center portion to simplify V-Belt installation and replacement. This "quick change" feature is completely safe and this new design has been found to have equal or greater strength than conventional type end-sills in every test.

Dayton Endless V-Belts Baggage Cars

gripping power and dependability of Dayton Endless Axle Drives.



Only Two Dayton Endless V-Belts required for car-lighting generator drives.

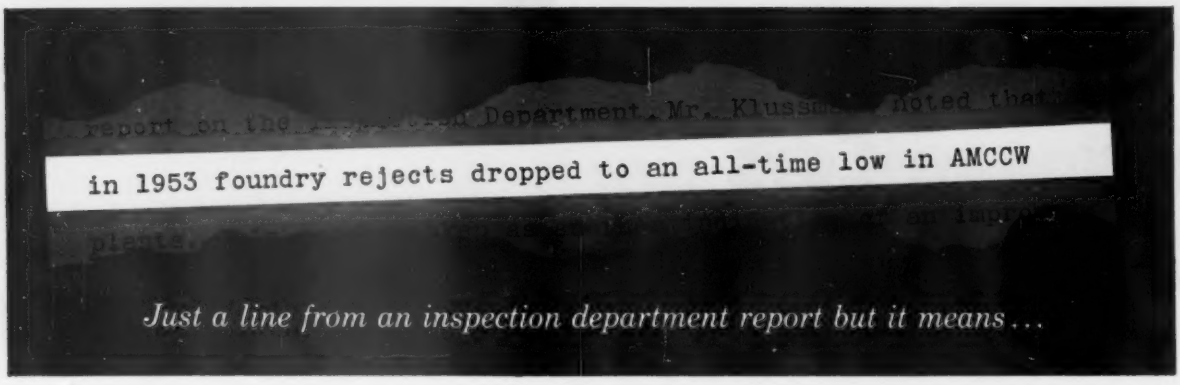
In conjunction with Dayton Field Engineers, Railway Engineers determined that two Dayton Endless V-Belts offered all the desired power for dependable, continuous, trouble-free Baggage-Express car-lighting. Based upon past success with Dayton Endless V-Belts, this railroad looks forward to saving costly hours of recharging as well as maximum lighted working hours.

Dayton Endless V-Belts Provide Certified Dependability . . . . Efficient, Economical Service.

Use of high tenacity rayon cord and red compound produce tough, rugged, Dayton Endless V-Belts which will outperform all others. Internal construction offers maximum horizontal and vertical flexibility; full plied core provides greater tensile strength and longer life.

Dayton Endless V-Belts Specified.

More and more cost-conscious railroads are specifying Dayton Endless V-Belts for every power need. Typical are the 63 new cars like the one above now being delivered to one of America's foremost railroads by The Budd Co. For complete information on Dayton Railway V-Belts or Cog-Belts®, or for assistance in solving a power transmission problem, write direct to Dayton Rubber Co., Railway Division, Dept. 213 Dayton 1, Ohio.



safer, better, chilled car wheels

When the general inspector visits an AMCCW foundry, he not only checks the inspection methods but molding procedure, cupola, pouring, and annealing practices. It is also standard practice for him to check all gauges in use by the resident inspector, as illustrated.

Map of AMCCW plant locations shows why you get quick low-cost delivery when you order chilled car wheels from the AMCCW plant near you.

When inspectors find fewer wheels to reject during the same year that some of the inspection tests became 25% tougher*, that's a good indication that the product is being improved. In this case it means that AMCCW plants are producing safer, more serviceable wheels for shipment.

Why can these chilled car wheels take it better than ever before? There are three simple reasons.

1. **Improved design—more brackets, thicker, heavier, and more continuous flange support and heavier tread.**

2. **Improved manufacturing methods.**

3. **The continued vigilance of the Association's uniform inspection by means of resident inspectors, general (traveling) inspectors, and central office inspection of production records.**

For a more complete description of the improved chilled car wheel that earned this all-time low in rejects but stands high in safety performance, send for the free booklet, "The Chilled Car Wheel."

**Time of thermal test and number of blows in impact test each increased 25% by the AAR in February 1953.*

Low first cost • Low exchange rates • Reduced inventory • Short haul delivery • Increased ton mileage • High safety standards • Complete AMCCW inspection • Easier shop handling

Association of Manufacturers of Chilled Car Wheels

445 North Sacramento Boulevard, Chicago 12, Illinois

Albany Car Wheel Co. • American Car & Foundry Co. • Marshall Car Wheel & Foundry Co. • Southern Wheel (American Brake Shoe Co.) • Griffin Wheel Co. Pullman-Standard Car Mfg. Co.

CLASS OF SERVICE

This is a full-rate Telegram or Cablegram unless its deferred character is indicated by a suitable symbol above or preceding the address.

WESTERN UNION

FX-1201

SYMBOLS

DL = Day Letter
NL = Night Letter
LT = Int'l Letter Telegram
VLT = Int'l Victory Ltr.

W. P. MARSHALL, PRESIDENT

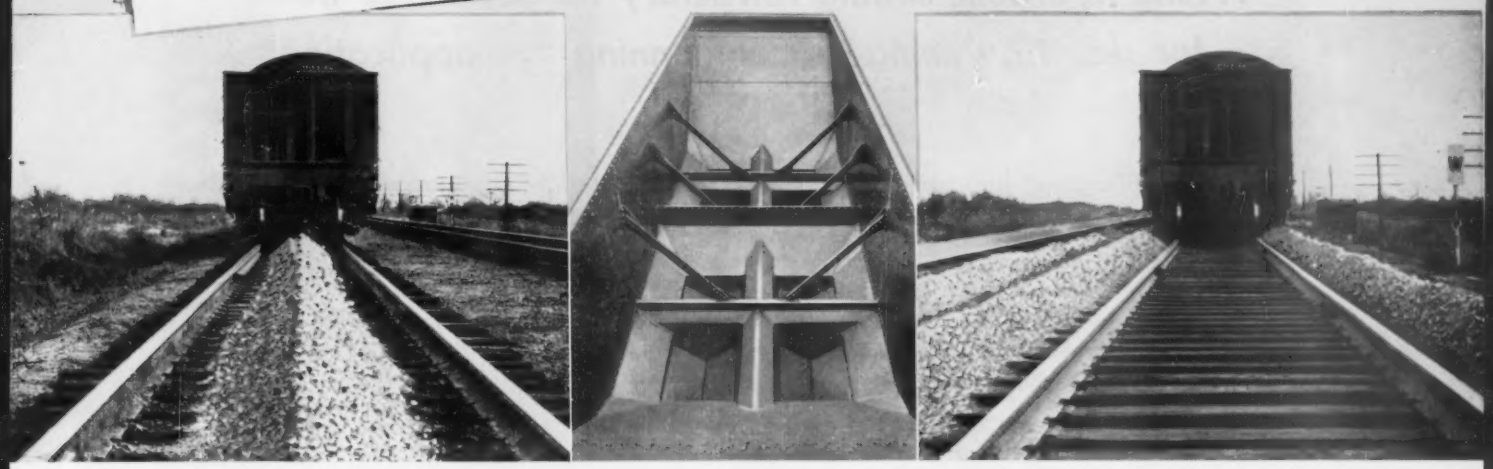
The filing time shown in the date line on telegrams and day letters is STANDARD TIME at point of origin. Time of receipt is STANDARD TIME at point of destination

MR. RAILROAD EXECUTIVE

THE USE OF ENTERPRISE BALLAST CARS ON YOUR RAILROAD WILL SAVE YOU TENS OF THOUSANDS OF MAN HOURS IN YOUR MAINTENANCE OF WAY PROGRAM WITH AVERAGE LABOR COSTS OF ONE DOLLAR AND FORTY SEVEN CENTS PER HOUR SAVINGS WILL BE SUBSTANTIAL THE ENTERPRISE BALLAST CAR IS ALSO AN IDEAL COMMERCIAL CAR FOR COAL SAND GRAVEL SUGAR BEETS AND OTHER BULK LADINGS.

ENTERPRISE RAILWAY EQUIPMENT COMPANY

THE COMPANY WILL APPRECIATE SUGGESTIONS FROM ITS PATRONS CONCERNING ITS SERVICE



The Enterprise ballast car distributes ballast exactly where needed —center, either side, or any combination of center and side.

4432 S

Door Operating Devices Exclusively Since 1903

ENTERPRISE RAILWAY EQUIPMENT COMPANY

59 East Van Buren Street • Chicago 5, Illinois

Workmen slap-trowelling 3X Blazecrete on walls of a Southern Railway power plant boiler

with Johns-Manville 3X BLAZECRETE

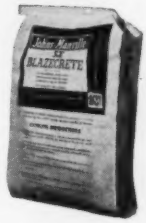
... the hydraulic setting refractory for service to 3000F

for slap trowelling or gunning applications

Just slap 3X Blazecrete* into place and trowel it smooth. It's as easy to work as concrete. No laborious ramming or tamping is required. That's why this hydraulic setting refractory material saves valuable man-hours and down-time when you reline boiler walls. And remember, 3X Blazecrete withstands temperatures up to a full 3000F.

Linings last longer—More economical to use, 3X Blazecrete linings last much longer in service.

Keeps in storage—Furnished dry in 100-lb. bags, 3X Blazecrete will not deteriorate when stored in a cool, dry place. Material can be used as needed.



*Reg. U. S. Pat. Off.

For the full Blazecrete story . . . for economical boiler relining jobs, ask for a free copy of Booklet RC-28A. Just write to Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay St., Toronto 1, Ontario.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville

95 YEARS OF SERVICE TO TRANSPORTATION

3 dollar-saving reasons why it pays to specify

Adlake Sectional Diaphragms

Longer life . . . Top and legs are *separate units*. This gives maximum flexibility and prevents pulling apart of the belting (which usually occurs first at corners). Adds years to the life of the diaphragm.

Economy . . . Since top and legs are independent, any damaged section can be replaced without installing a whole new unit.

Self-cleaning construction . . . Sloping top permits quick drainage, so dirt, cinders, snow, etc., can *not* accumulate to hold moisture.

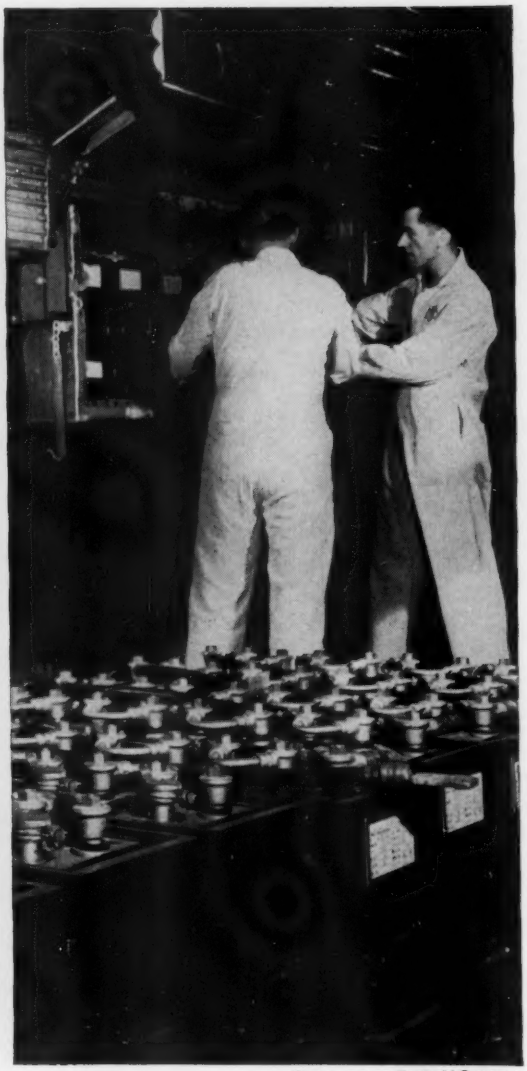
Yes, ADLAKE Sectional Diaphragms save you money by giving trouble-free, low-cost service for extra years. Get the full story on ADLAKE's efficient economy today . . . drop a card to 1152 N. Michigan, Elkhart, Indiana. No obligation, of course.

Adlake TRADE MARK — 97th year of serving the transportation and building industries

THE Adams & Westlake COMPANY

Established 1857 ELKHART, INDIANA New York • Chicago

Manufacturers of ADLAKE Specialties and Equipment for the Railway Industry



Photos: courtesy The Budd Company

Passenger comfort, unlimited

Today's modern air-conditioned passenger cars call for simple and reliable apparatus which must provide dependable service at the lowest over-all cost. That's why it's so important to investigate the tremendous advantages in EDISON batteries for standby power for the electrical systems of these cars. They are of steel-cell construction, built to take rugged handling like no other kind of battery construction can.

Electrically, too, EDISON batteries are profitably different—they have no prescribed discharge limits and, therefore, operate self-regulating a-c inversion apparatus correspondingly longer without injury to the battery. Recovery after discharge is usually just as rapid as generator output permits, resulting in high road capacity and virtual elimination of yard charging.

Roads using as many as 2000 sets of EDISON batteries in both air-conditioned and non-air-conditioned cars report average service life ranging from 18 to 26 years. Find out now about EDISON's exclusive advantages by sending for our bulletin 3802 and requesting a visit from the Edison field engineer nearest you. Write Edison Storage Battery Division, Thomas A. Edison, Incorporated, West Orange, New Jersey.

Most dependable power . . .
lowest over-all cost
you get both with an EDISON

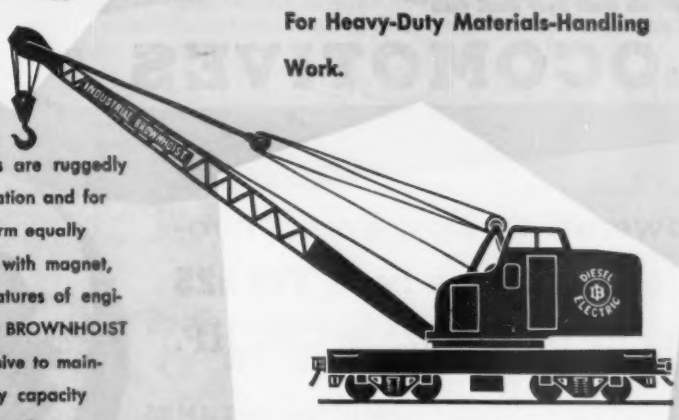
EDISON
Nickel • Iron • Alkaline
STORAGE BATTERIES

EDISON ALSO MAKES THE FAMOUS "V.P." VOICEWRITER AND THE TELEVOICE SYSTEM

INDUSTRIAL BROWNHOIST 250 TON

THE WORLD'S LARGEST DIESEL POWERED RAILROAD CRANE

Designed primarily for Railroad Emergency Service, this 250-Ton Crane is the biggest member of the BROWNHOIST Family of Powerful Locomotive Cranes For Heavy-Duty Materials-Handling Work.



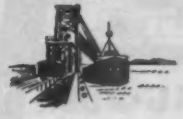
Brownhoist Diesel Locomotive Cranes are ruggedly built for continuous, heavy-duty operation and for long, dependable service. They perform equally well as switch engine or crane and with magnet, hook or bucket. Many advanced features of engineering design and construction make BROWNHOIST Cranes easy to operate and inexpensive to maintain. Standard models to meet every capacity requirement. Write for complete information.

BROWNHOIST builds better cranes

CLAMSHELL BUCKET

COAL-ORE BRIDGE

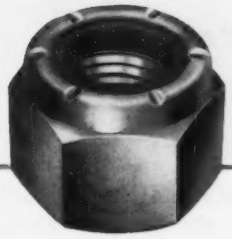
CAR DUMPER



INDUSTRIAL BROWNHOIST CORPORATION, BAY CITY, MICHIGAN • DISTRICT OFFICES: New York City, Philadelphia, Cleveland, San Francisco, Chicago; Canadian Brownhoist Ltd., Montreal, Quebec • AGENCIES: Detroit, Birmingham, Houston, Los Angeles.

Step in the right direction

...safety devices



secured with *Elastic Stop*® nuts

***safety appliances and others such as:**

coupler carriers
draw gears
pedestal tie bars
brake rigging
spring equalizer seats
truck mounted equipment
center plate bolts
miscellaneous equipment on under frame

Today, major Diesel builders are using Elastic Stop nuts for a variety of critical applications.* No other fastener provides so much positive protection against the pounding vibration that is a part of modern high speed freight and passenger operation.

Elastic Stop nuts offer production and maintenance advantages, too. The same elastic collar that damps out vibration makes the nuts self-locking—a one-piece assembly—and reusable many times.

Many roads are replacing double nuts or castellated nuts with Elastic Stop nuts wherever safety of personnel and maintenance costs are factors. ESNA can serve you better on these and all other critical applications.

Elastic Stop Nut Corporation of America
also maker of the ROLLPIN

ROLLPIN TRADEMARK

Mail Coupon

for further information on ESNA® self-locking fasteners for locomotives, freight and passenger cars.

Dept. N61-523, Elastic Stop Nut Corporation of America
Railway Sales Division
2330 Vauxhall Road, Union, N. J.

Please send me the following free information:

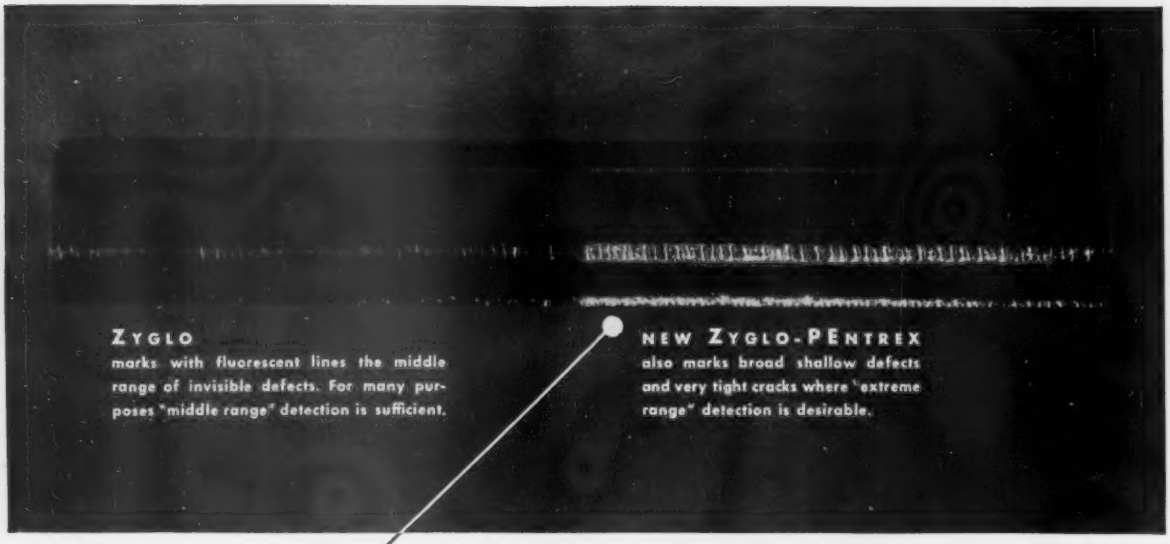
☐ Elastic Stop nut bulletin
☐ Rollpin bulletin
☐ Here is our problem. What fastener do you suggest?

Name_____ Title_____

Firm_____

Street_____

City_____ Zone____ State_____



Now, ZYGLO-PENTREX

A Super-Sensitive Fluorescent Penetrant for *Extreme Range* Defect Detection

Zyglo-PEntrex is a new penetrant, specifically developed for the detection of extremely fine or shallow defects in parts whose application makes such defects critical.

Its first pilot use was in the important inspection of gas turbine buckets . . . then in high alloy diesel valves, extruded aluminum and heavy aluminum forgings.

Zyglo-PEntrex is the first *extreme range* penetrant. Its great advantage and unique characteristic is to widen the area of effective penetrant inspection at *both* extremes—to find *both* very tight cracks and broad, shallow defects often missed by other penetrants. It also shows up *all* defects with more brilliant and easily seen indications.

Not all inspection requirements call for the extreme sensitivity of Zyglo-PEntrex. For many, inspection with standard Zyglo is sufficient. But, if you produce or work with non-magnetic parts in which defects even at the extreme ranges of detection can be critical, new Zyglo-PEntrex is effective beyond anything heretofore available. Fully automatic inspection, using regular Zyglo equipment can be provided. Write us now for full details.

Why ZYGLO-PENTREX *is More Sensitive*

Because Zyglo-PEntrex contains no emulsifier, it tends to have greater penetrating power. With "post emulsification," the emulsifier is applied after penetration of the part. Both emulsion time and washing can be controlled to suit the particular part or type of defect, to produce maximum visibility and brilliance of indications. Zyglo-PEntrex contains a much higher concentration of brighter fluorescent dyes. It also has greater dissolving powers, enabling it to penetrate into some types of contaminated cracks which would otherwise be impossible to find.

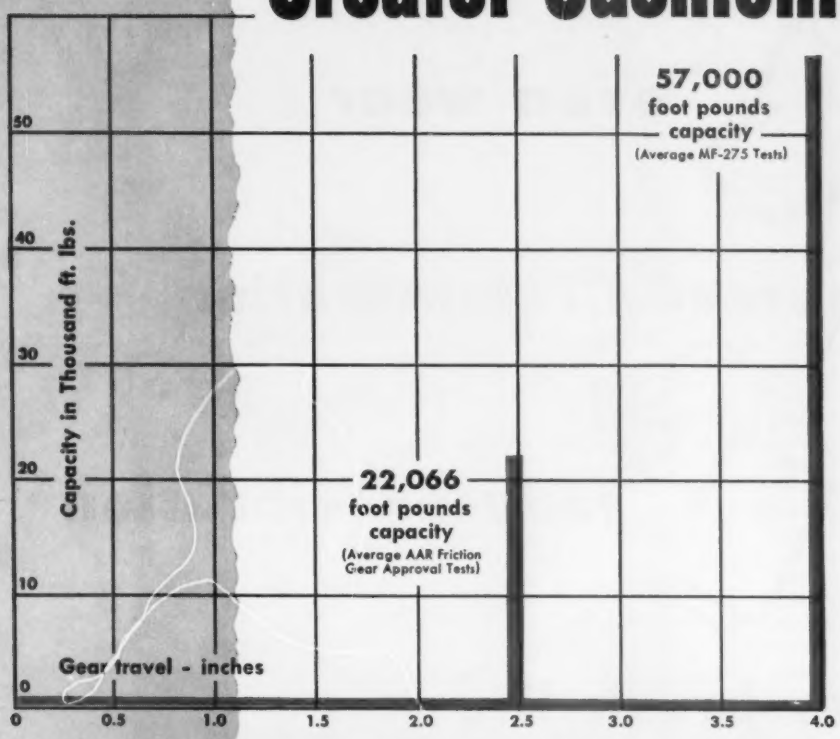
Magnaflux Has A Complete Line To Meet Inspection Requirements For All Types Of Materials And Sensitivity Needs. Write For Free Booklet "Seeing Isn't Always Believing".

MAGNAFLUX

DETECTS DEFECTS

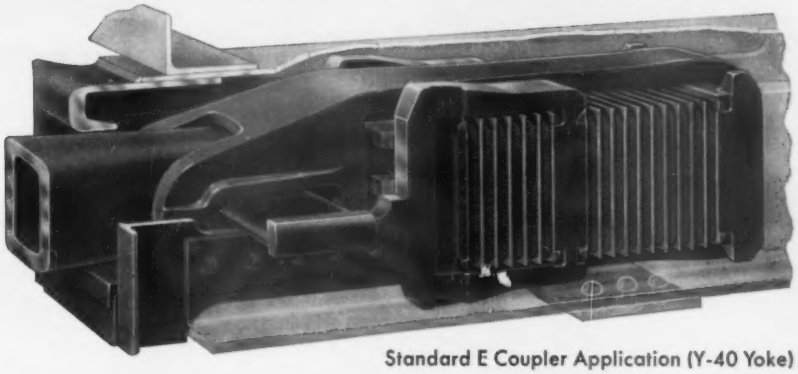
MAGNAFLUX CORPORATION
7320 West Lawrence Ave., Chicago 31, Illinois
New York 36 • Pittsburgh 36 • Cleveland 15
Detroit 11 • Dallas 9 • Los Angeles 58

Greater Cushioning Capacity



through longer travel

NATIONAL Multi-Pad Rubber Draft Gear



Standard E Coupler Application (Y-40 Yoke)

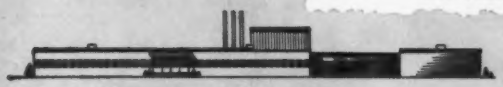
With more gear travel in buff, the National MF-275* rubber gear gives greater cushioning capacity — *where it counts* — than certified friction gears. Tests have shown 57,000 foot-pounds capacity at the 4-inch travel mark.

Which all adds up to delivery of undamaged lading for increased customer good will — and dollars saved in damage claims and car maintenance! A-8801

Fits Standard AAR yokes and standard car construction with no slack in yoke or pocket!

Technical Center
Cleveland

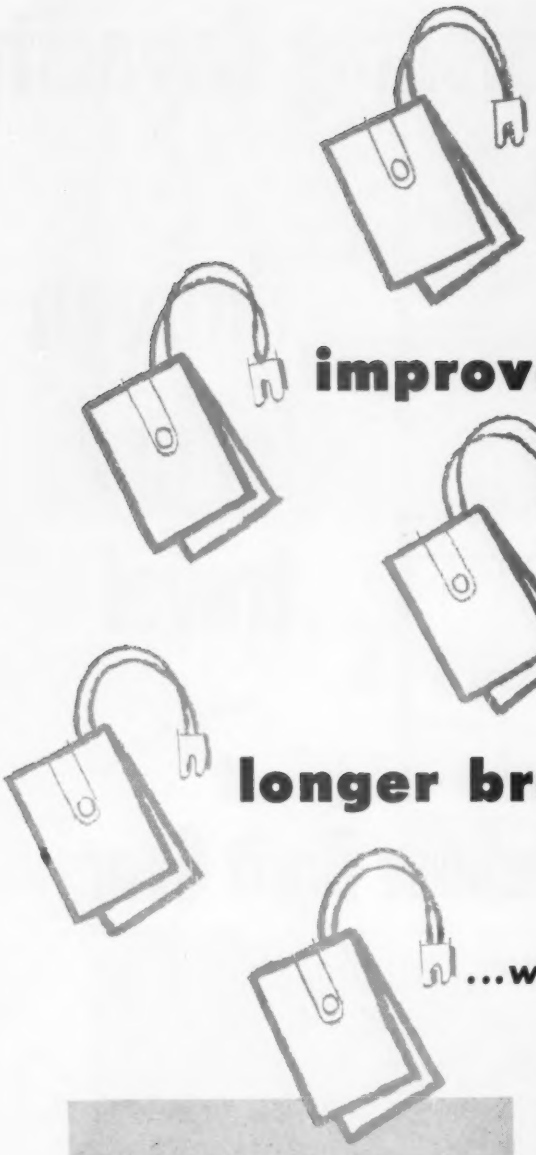
*AAR Certified



"Progress through Research"

NATIONAL MALLEABLE and STEEL CASTINGS COMPANY
Cleveland 6, Ohio

COUPLERS • YOKES • FREIGHT TRUCKS • DRAFT GEARS—RUBBER AND FRICTION
JOURNAL BOXES AND LIDS



even wear

improved commutation

reduced vibration

longer brush life

...which would you rather have?

There's a Speer Application-Tested Brush for every railroad use:

Traction Motors • Main Generators • Auxiliary Generators • Motor Generators and Dynamotors • Traction Motor Blowers • Exciters • Fuel Pump Motors

You'll never have to choose... because Speer MULTIFLEX* Brushes offer you *all four.*

Reason: their patented two-section construction. It lets them operate in single-brush holders yet gives them all the important double-brush advantages.

And with MULTIFLEX Brushes, these are advantages you can count on. For like all Speer Brushes (see panel), MULTIFLEX Brushes are application tested *two ways.*

First: by hours and hours of laboratory runs. *Second:* by thousands of miles of carefully observed, on-the-job operation.

Next time, specify the single brushes with the double-brush advantages... get even wear, improved commutation, reduced vibration, longer brush life.

Specify Speer MULTIFLEX Brushes.

*Patent No. 2,181,076

SPEER Carbon Co.

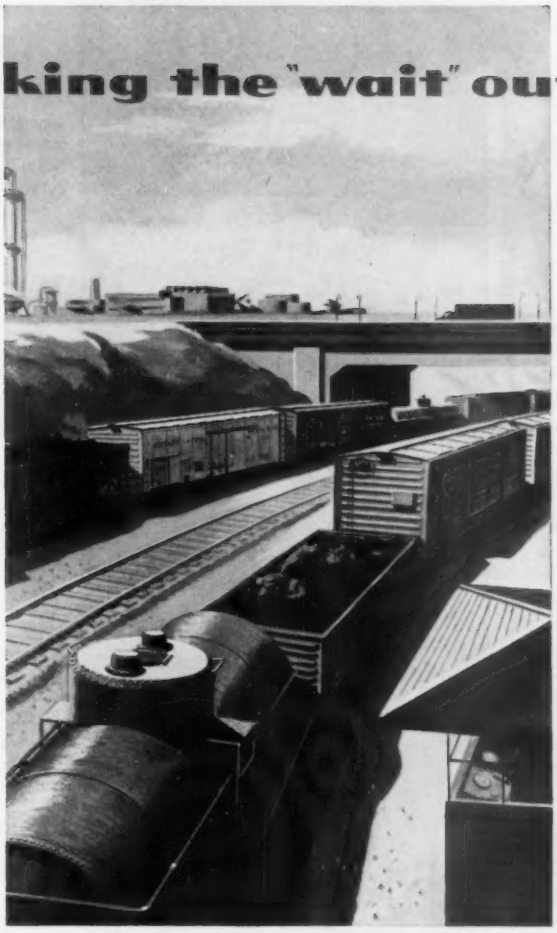
St. Marys, Pa.

Divisions:

Speer Resistor • Jeffers Electronics

International Graphite & Electrode

Taking the "wait" out of freight...



RUNNING MATE OF DIESEL FREIGHT

HYATT ROLLER BEARINGS

Have you wondered if diesel freight will ever move as smoothly and swiftly as modern passenger trains? It will—and *soon!* The railroads—through the adoption of *Hyatt Roller Bearings* for freight cars—are eliminating the hot box problem, greatest single obstacle to streamliner speeds for freight. In passenger travel, hot boxes are virtually unknown, because modern roller bearings have been standard on passenger cars for years. Now, the spotlight is on freight, and the railroads are investing millions in Hyatt-equipped cars, automatic switching and signaling systems, and push-button yards. The day is coming when every freight train will roll on an express schedule—*with far greater safety!*

HYATT

STRAIGHT ROLLER BARREL ROLLER TAPER ROLLER

ROLLER BEARING JOURNAL BOXES

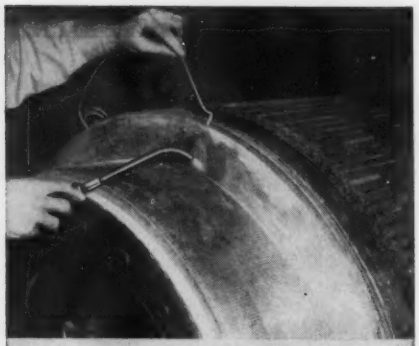
HYATT BEARINGS DIVISION • GENERAL MOTORS CORPORATION • HARRISON, NEW JERSEY

Prest-O-Lite
Trade-Mark

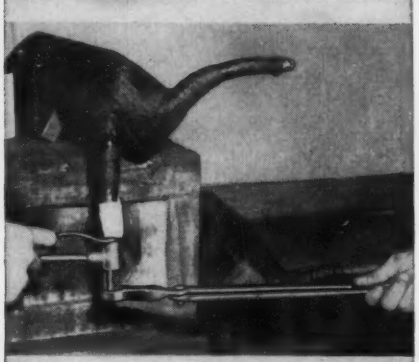
TORCH

Big Time-saver in Diesel Maintenance

Is your diesel electrical shop using PREST-O-LITE torches for the many heating and soldering jobs they have? If not, they are overlooking the quickest and most economical source of heat. At the flick of a lighter the PREST-O-LITE torch gives an instant flame temperature of 4000 degrees Fahrenheit — clean heat under complete fingertip control. Illustrated are just a few of the many applications where PREST-O-LITE torches are saving time and money. You can do these and many other jobs, too. Ask an OXWELD representative to show you one of these big time-savers.

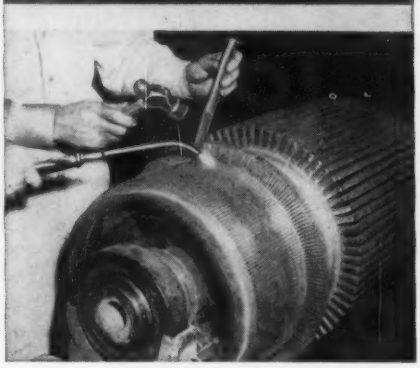


Generator commutator risers are efficiently soldered with a PREST-O-LITE torch.



Applying a lug to a diesel coil lead is a matter of seconds using a PREST-O-LITE torch.

Many soldering jobs like joining lugs to motor leads are done quickly and easily with a PREST-O-LITE torch.



A PREST-O-LITE torch provides quick heat to remove coil ends from a traction motor armature.

OXWELD RAILROAD SERVICE COMPANY
A Division of Union Carbide and Carbon Corporation
UCC
Carbide and Carbon Building Chicago and New York
In Canada:
Canadian Railroad Service Company, Limited, Toronto

OXWELD RAILROAD SERVICE

SINCE 1912 THE COMPLETE OXY-ACETYLENE SERVICE FOR AMERICAN RAILROADS

"Prest-O-Lite" and "Oxweld" are registered trade-marks of Union Carbide and Carbon Corporation.

On the VIRGINIAN RAILWAY VGN

45,600 Horsepower Train Master Pool set up to cut time and costs

Train Master power demonstrated to the Virginian that a pool of TM motive power units could handle their coal train operations better, at less cost, and at a lower initial investment than any other type of locomotive.

Invest in Train Masters . . . add to profits . . . not to costs

TRAIN MASTER

. . . leader in today's trend toward more powerful, more useful Diesel motive power.
Fairbanks, Morse & Co., 600 South Michigan Avenue, Chicago 5, Illinois.

FAIRBANKS-MORSE
a name worth remembering when you want the best

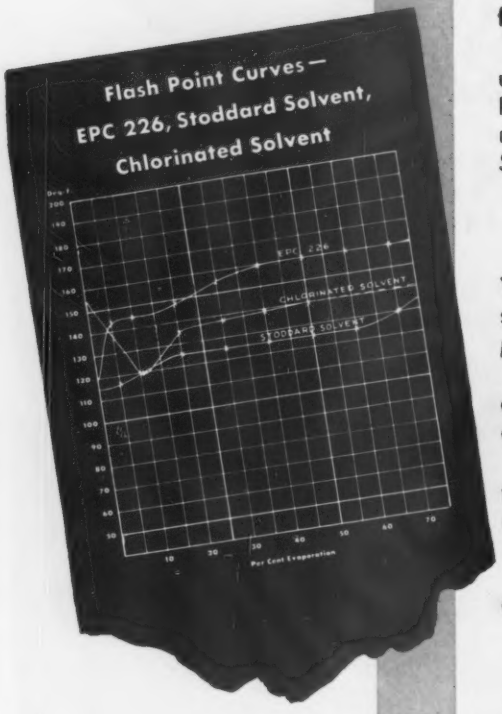
DIESEL LOCOMOTIVES AND ENGINES • RAIL CARS AND RAILROAD EQUIPMENT • ELECTRICAL MACHINERY • PUMPS • SCALES • WATER SERVICE EQUIPMENT • HAMMER MILLS • MAGNETOS

A high initial Flash Point doesn't tell the whole story!

Initial flash point determinations on solvents that contain mixtures of chlorohydrocarbons can be *misleading.*

Chlorinated compounds evaporate at a faster rate than the other ingredients in a halogenated type solvent, *lowering the temperature* **at which a mixture of the solvent vapor with air will flash if exposed to an unprotected flame.**

To illustrate: Though the initial flash point of a solvent that utilizes chlorinated compounds may be as high as 200 degrees Fahrenheit, or even masked initially, such a material may, nevertheless, *flash at some point lower than that of Stoddard Solvent* after 10 per cent evaporation.



CLEANING ELECTRICAL PARTS WITH YOSEMITE EPC 226

Yosemite Chemical Company has perfected a particularly safe solvent to meet the requirements of those railroads *primarily concerned with personnel and equipment safety.*

Yosemite EPC 226 is a non-chlorinated electrical parts cleaner that is as *safe as Stoddard Solvent,* **and a better cleaner than carbon tetrachloride.**

Electrically conductive soil is effectively removed from traction motors, generators, switch gear panels and boards, and from other types of electrical equipment.

Check these EPC 226 safety features:

- *The flash point of EPC 226 is higher than that of Stoddard Solvent initially, and remains so throughout the evaporation cycle. The flash point actually goes up after 10 per cent evaporation.*
- *The Maximum Allowable Concentration rating is similar to that of Stoddard Solvent, and the odor of EPC 226 is milder than that of chlorinated solvents used in the cleaning of electrical parts.*
- *EPC 226 will not corrode metal, leaves no residue upon evaporation. The evaporation rate is not so fast as to induce moisture condensation and soil redeposition, nor so slow as to appreciably lengthen drying time.*

Compare your present electrical parts cleaner with Yosemite EPC 226 and prove to yourself that EPC 226 is the safer, more effective and more economical solvent.

FREE

Test procedures developed for the evaluation of electrical parts cleaners, and descriptive literature on EPC 226 are now available. Write: *Yosemite Chemical Company, Railroad Division, 1040 Mariposa Street, San Francisco 7, California.*

Yosemite CHEMICAL COMPANY

1040 Mariposa Street, San Francisco 7, Calif.
1506 So. Santa Fe Street, Los Angeles 21, Calif.
844 No. Halstead, Chicago 22, Ill.

A.A.R. APPROVED

Freight Car Trucks

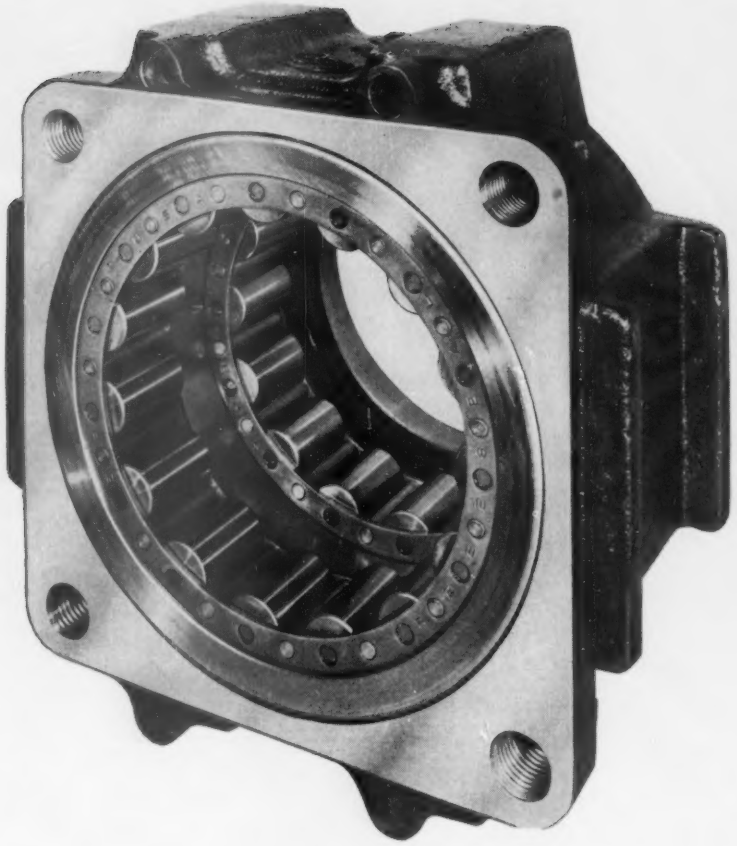
proved
by millions
of service miles

SCULLIN STEEL CO.

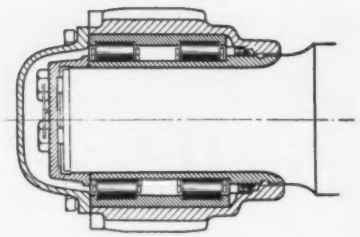
STEEL CASTINGS MANUFACTURER

SAINT LOUIS 10, MISSOURI

NEW YORK
CHICAGO
BALTIMORE
RICHMOND, VA.
CLEVELAND



This is the Bower-Franklin Roller-bearing journal box for freight cars



The straight roller bearings for this freight car journal box are made by the Bower Roller Bearing Company of Detroit. The inner race fits standard AAR roller bearing axles. Two rows of straight rolls, running between the inner and outer races are positioned by a sturdy retainer. The one-piece outer race is contained in a separate, ruggedly built journal box housing. The bearing permits free lateral movement of the axle up to $\frac{1}{2}$ inch.

Another point to remember about Bower Franklin bearings is that they permit bearing interchange with minimum parts inventory. Complete box and bearing units slip off the axle without disturbing the inner race. No need to carry spare wheel sets with bearings and boxes applied. Ask us to send you complete facts today.

FRANKLIN BALMAR CORPORATION

FRANKLIN BALMAR CORPORATION
WOODBERRY, BALTIMORE 11, MARYLAND
CHICAGO OFFICE: 5001 North Wolcott Ave., Chicago 40

Improve the Riding of Your Existing Passenger Cars

with the

CENTRAL BEARING

Eliminates Lateral Shimmy—Increases Wheel Mileage

The new Central Bearing, developed by General Steel Castings, is now in service on several hundred cars and on order for many hundreds more. It provides a simple, proven way to assure smoother, more comfortable riding of your existing passenger train cars, and substantially reduces upkeep cost.

Truck shimmy and side bearing problems are eliminated with the Central Bearing, and mileage between wheel turnings is greatly increased.

The Central Bearing requires no lubrication.

Available in a simple, easy-to-install "package", Central Bearings may be readily applied to passenger train cars at small expense. They occupy the space formerly used by the center plates.

For the utmost in riding comfort, it will pay you to equip your existing passenger cars now with Central Bearings, and to specify them for your new equipment.

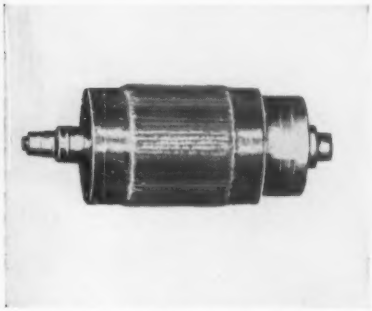
GENERAL STEEL CASTINGS

GRANITE CITY, ILL. EDDYSTONE, PA.

IRVINGTON INSULATING VARNISH DIGEST

New Varnish Has Very High Strength, Resists Vibration

A new insulating varnish, designated as Irvington No. 140, has been specifically formulated to provide a high degree of electrical and physical protection on windings exposed to extreme mechanical stresses. Because of its high strength, this new varnish prevents coil or wire movements on units operating under conditions of severe vibration.



Armatures for traction motors and generators on Diesel-electric trains are among potential railroad uses for Irvington Varnish No. 140.

Railroad Applications

Major applications of Irvington No. 140 in the railroad field are expected to be found in the impregnation of windings on Diesel-electric traction motors and generators, where its strength and ability to resist vibration are especially important.

Other service advantages offered by No. 140 are its excellent electrical properties and its resistance to high temperatures and the effects of water, oils, acids and alkalies.

High Stability

This varnish also displays excellent stability, both during storage and in the dip tank. Use of a relatively mild solvent minimizes the danger of any attack by the varnish on the components of the windings.

Vacuum-Pressure Varnish Application Penetrates Windings More Completely

Method Extracts Air from Pores, Capillary Vessels; Results in Better Insulation of Electrical Windings

While satisfactory results in the impregnation of electrical windings by insulating varnishes can frequently be obtained with the relatively simple equipment used for dipping procedures, more effective penetration results from the use of the vacuum-and-pressure method. In this type of application, air is first evacuated from the impregnating tank. Varnish is then pumped from a storage tank into the impregnating tank, and pressure is applied.

Internal curing varnishes, which cure throughout by polymerization, are particularly well adapted to make most effective use of the thorough penetration resulting from the vacuum-pressure method.

Equipment of this type, designed for application of vacuum and pressure within the impregnating tank, assures more effective penetration of windings by insulating varnishes

Design of Baking Oven Important in Results

Baking ovens for the curing of insulating varnishes should be provided with means for carrying off solvent vapors. A well designed ventilating system is required.

The oven should provide uniform, dry heat with proper temperature control. Gas, steam or electricity may be used as the means of heating. For increased curing speed in continuous-line production, infrared heating may be used, particularly for the curing of the internal drying types of varnish.

Preheating of Work

Because these internal curing varnishes tend to increase in viscosity at elevated temperatures, the recommended procedure is to preheat the work in an oven, rather than in the impregnating tank itself. This procedure decreases the danger of thermal shock to the varnish, which might occur on coming into contact with a heated impregnating tank.

The preheated pieces should be transferred from the oven to the impregnating tank as quickly as possible to prevent cooling.

Vacuum and Pressure Conditions

After closing the cover of the impregnating tank, a vacuum of not less than 28 inches should be maintained for about one hour. After this period, varnish should be pumped from the storage tank to the impregnating tank until the work pieces are submerged.

After immersion, the impregnation chamber should be exposed to atmospheric or abnormal pressure. If abnormal pressures are necessary an inert gas is recommended. Units should remain in the varnish for approximately one hour.

Procedure will vary slightly for different types of windings. Recommendations for specific applications are available on request from Irvington.

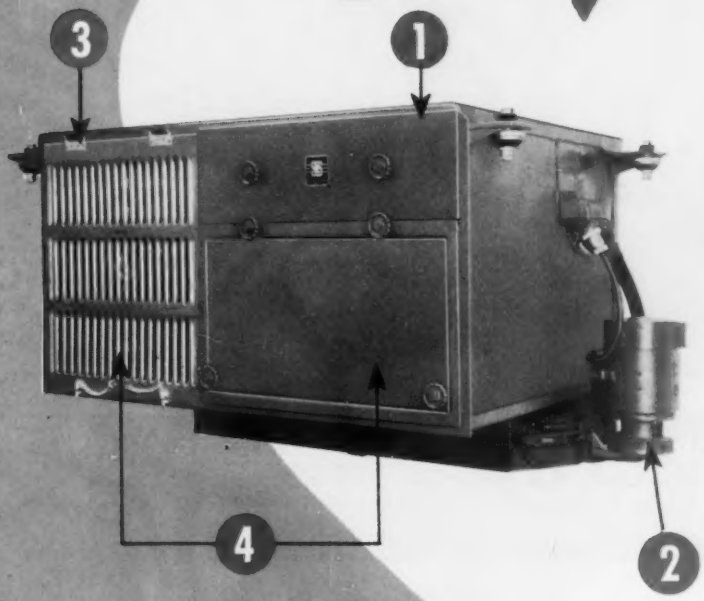
(For information, write Varnish Dept., Irvington Varnish & Insulator, Div. of Minnesota Mining & Mfg. Co., Irvington, N. J.)

FOR INCREASED COOLING CAPACITY

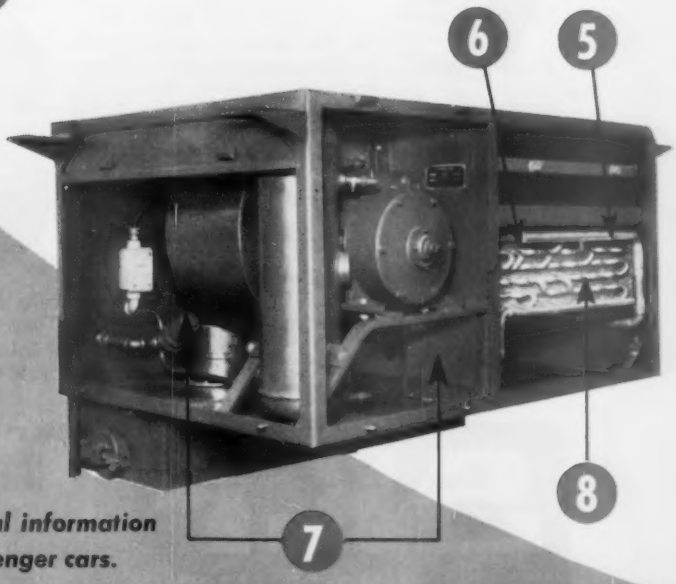
on air conditioned cars now using air cooled condensers, install...

EVAPORATIVE CONDENSERS.....

by "Safety" featuring...



1. greater cooling capacity at high ambient temperatures
2. less power demand
3. reduced space requirements
4. silicon bronze casing . . . stainless steel air intake grille



5. lower head pressure under all operating conditions
6. non-clogging spray header
7. complete accessibility for servicing
8. single coil replacing two on air cooled unit . . . or three if sub-cooler is now used

Contact your nearest "Safety" district office for additional information concerning complete air conditioning equipment for passenger cars.

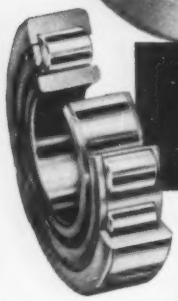
THE **SAFETY** CAR HEATING AND LIGHTING **COMPANY** INC.

NEW YORK · CHICAGO · PHILADELPHIA · ST. LOUIS · SAN FRANCISCO · NEW HAVEN · MONTREAL

SAFETY COMPANY PRODUCTS INCLUDE: Air-conditioning Equipment • Genemotors • Generators • Fans • Regulators • Blower Units Lighting Fixtures • Switchboards • Luggage Racks • Motor Alternators • Dynamotors • Motor Generators • Dual Voltage MG Sets

THE TRACTION MOTOR BEARING PIONEER STILL LEADS

Now, It's SKF's M-2 Cage, Providing Easy Inspection Of All Bearing Surfaces



It's the easiest thing in the world to disassemble SKF's *Pinion End Traction Motor Bearings* for inspection; just slide out the inner ring. You can then move the rollers out of the outer ring groove, and rollers and M-2 Cage slide right out. Reassembly is just as easy.

This roller riding cage has another advantage – it is easier to lubricate.

Crowned rollers provide maximum capacity in minimum space.

HERE IS SKF'S COMMUTATOR END CYLINDRICAL ROLLER BEARING

It, too, has SKF's M-2 Roller Riding Cage for easy disassembly and inspection.

Crowned rollers provide maximum capacity in minimum space. Positively stabilizes the armature and holds it in proper position in the motor frame. 7442

Specialized SKF Distributors, strategically located, have adequate stocks of SKF Traction Motor and Generator Bearings. They can make immediate deliveries from stock.

SKF INDUSTRIES, INC., PHILADELPHIA 32, PA.

– manufacturers of **SKF** *and* HESS-BRIGHT *bearings.*

SKF

TRACTION MOTOR BEARINGS

SKF Pioneered These Traction Motor Bearing Developments . . .

1939 Crowned Rollers which increased capacity.

1943 Assisted Railroads in developing "SEALED GREASE LUBRICATION".

1945 Larger, longer rollers.

1948 Cage re-design to provide easy disassembly and reassembly.

1952 Longer life M-2 Cage, roller centered, while retaining all previous improvements. Sealed grease lubrication runs up to 500,000 miles without attention.

This advertisement is one of a series currently running in national business magazines. We sponsor it in the belief that such a series will help make industry more aware of the outstanding record of railroad progress and achievement.

How all industry benefits from progressive railroading

Industry benefits from the efficiency of today's modern car pool. Average ton-miles hauled per train hour shot up 74% from the 1936-1940 period!

TODAY... a freight car is nearer your telephone

The last two years have seen a spectacular reduction in freight car "shortage" reports. In 1952, the cases where shippers waited more than 48 hours for a car were 84% fewer than in 1950!

To provide this improved service, railroads retired over 115,000 old cars in '51 and '52 alone; replaced them with 155,147 new cars—enough to form a train 1,320 miles long! It meant a whopping investment of $1¼ *billion*. But, modern cars permit better *utilization*, one of the many reasons why a phone call brings them to your loading dock faster.

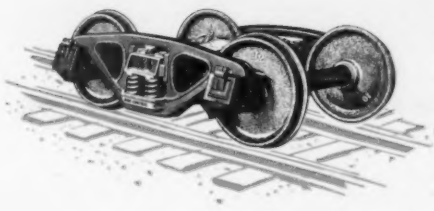
Railroads are also modernizing existing cars. Thousands are now equipped with the "Ride-Control® Package," developed by American Steel Foundries to replace the hard-riding springs on older cars. Package installations bring these cars up to modern riding standards, suitable for unrestricted use at unrestricted speeds. *All this at costs that measure up to the economic realities of general repairs programs.*

In short, a constantly replenished and modernized car pool is another reason why railroads offer better freight service at a bigger value than ever before.

American Steel Foundries

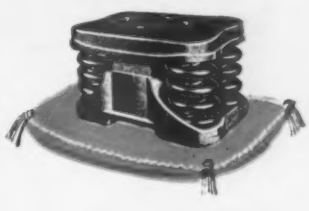
World's largest producers of railroad running gear

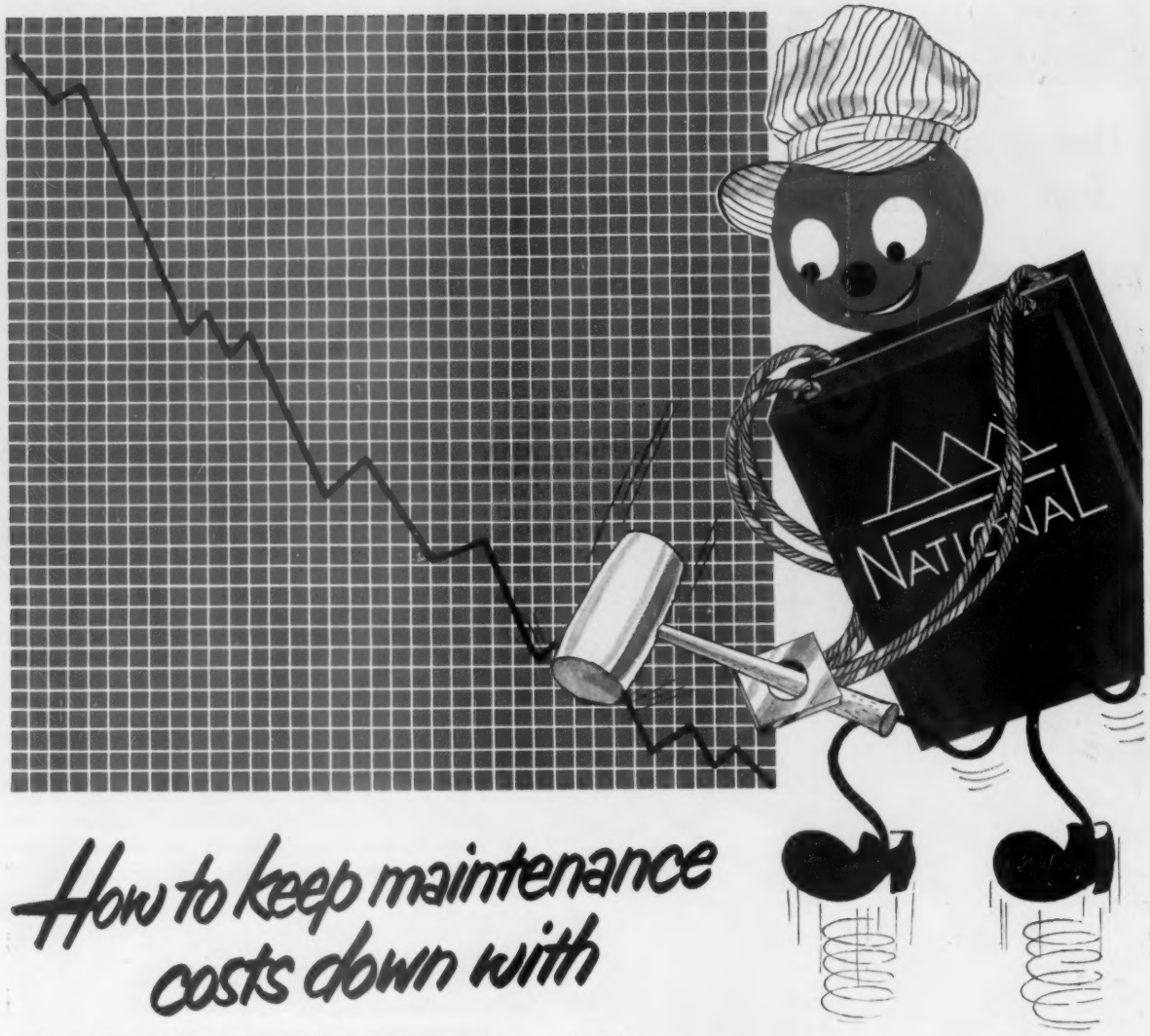
Executive Offices: Wrigley Building, Chicago 11



New freight cars ride smoothly at passenger-train speeds, on ASF Ride-Control® Trucks . . . specified on more new cars than all other freight car trucks combined!

And now the Ride-Control Packages are being used to modernize existing cars—*at realistic costs*. Recent tests prove reductions in lading damage index of over 90%.





How to keep maintenance costs down with

NATIONAL BRUSHES

TRADE-MARK

LOW MAINTENANCE COST and high pay-load return *start* with "National" brushes . . . the finest money can buy.

These brushes work hand in hand with *preventive* maintenance to cut costs...and *keep* them at a minimum.

Here's how: A PROPERLY MAINTAINED COMMUTATOR surface is easy on the brushes and gives the best commutation while the superior electrical properties and film-forming characteristics of "National" brushes, in their turn, *help* maintain the kind of commutator surface that's best for them . . . *and best for you.*

STAY MILES AHEAD with "National" brushes and keep maintenance on the low-cost *preventive* side!

How good is really good brush performance?...
use "National" brushes and see!

The term "National", the Three Pyramids device, and the Silver Colored Cable Strand are registered trade-marks of Union Carbide and Carbon Corporation

NATIONAL CARBON COMPANY
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N. Y.
District Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco
IN CANADA: Union Carbide Canada Limited, Toronto

GAIN THESE ADVANTAGES with MET-L-WOOD

METAL BONDED TO PLYWOOD

for new and rebuilt Passenger Car Interiors

FAST ASSEMBLY with Met-L-Wood, whether you fabricate in your shops or use prefabricated Met-L-Wood panels made to your exact specifications.

LIGHT WEIGHT Met-L-Wood panels can reduce weight to as low as 27% of the weight of comparable steel construction.

SOUND-DEADENING value of Met-L-Wood reduces outside noise levels, and is particularly valuable as sound-isolation when used for compartment partitions and doors.

VIBRATION DAMPING effect of Met-L-Wood helps prolong car life — gives passengers extra comfort.

and Smooth, Durable Beauty!

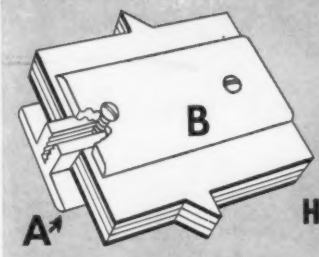
Whether plastic, painted steel, stainless steel, or aluminum, the smooth sweep of Met-L-Wood panels adds beauty to any car interior. Tough, abuse-resisting surfaces keep car interiors new-looking for years.

Details and technical data on Met-L-Wood panels, doors and partitions will be sent promptly on request.

Write for Bulletins 520 and 521

MET-L-WOOD CORPORATION

6755 West 65th Street, Chicago 38, Illinois

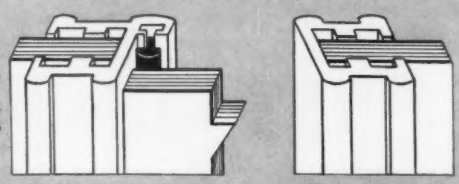


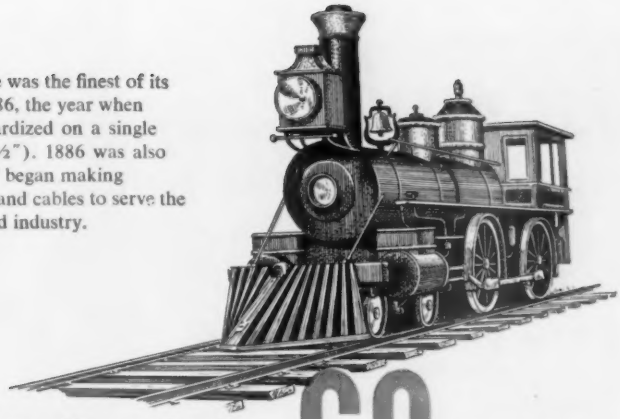
NEW PANEL JOINT HARDWARE

Met-L-Wood panels can now be joined faster and more easily with this new extruded aluminum hardware. Strip A has a grooved slot which provides strong threads for standard 10-24 machine screws anywhere along its length. Strip B can be drilled for screws at convenient points along the panel joint.

PANEL EDGE FITTINGS

Extruded aluminum fittings for Met-L-Wood panel edges improve partition and door appearance and give permanent edge protection. Left below is the fitting for door stops. Keyed slot holds molded rubber bumper firmly and permanently. At right is edge fitting for sliding doors and partition edges. Both fittings are easy to install on Met-L-Wood panels.





This locomotive was the finest of its type back in 1886, the year when railroads standardized on a single gauge (4 ft., 8½"). 1886 was also the year "U. S." began making electrical wires and cables to serve the growing railroad industry.

In step with America's Railroads for 68 years

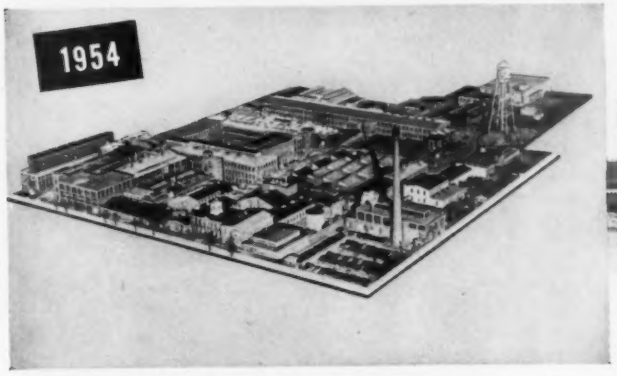
U. S. Electrical Wires and Cables

Year by year, America's railroads become more and more dieselized and electrified. That steps up the demand for electrical wires and cables. But it also means that manufacturers have to turn out wires and cables of tougher specifications, greater durability, wider versatility. The tremendously complex centralized traffic control systems and other "push-button" devices need the finest wires and cables obtainable.

United States Rubber Company is right in the middle of this tremendous railroad electrification growth. For 68 years "U. S." has been supplying railroads with the wires and cables required—as well as *anticipating* future demands. "U. S." has gone along side by side with the railroads, as they grow into an ever stronger national transportation system—a system unmatched in economy, efficiency and safety.

"U. S." is the only wire and cable manufacturer growing its own natural rubber, making its own synthetic and plastic compounds. Through this unequaled *control of manufacture*, "U. S." can always guarantee *superior insulation* in every type of wire and cable it produces.

Above is the United States Rubber Company wire and cable factory in 1886. Below (left) as it looks today.

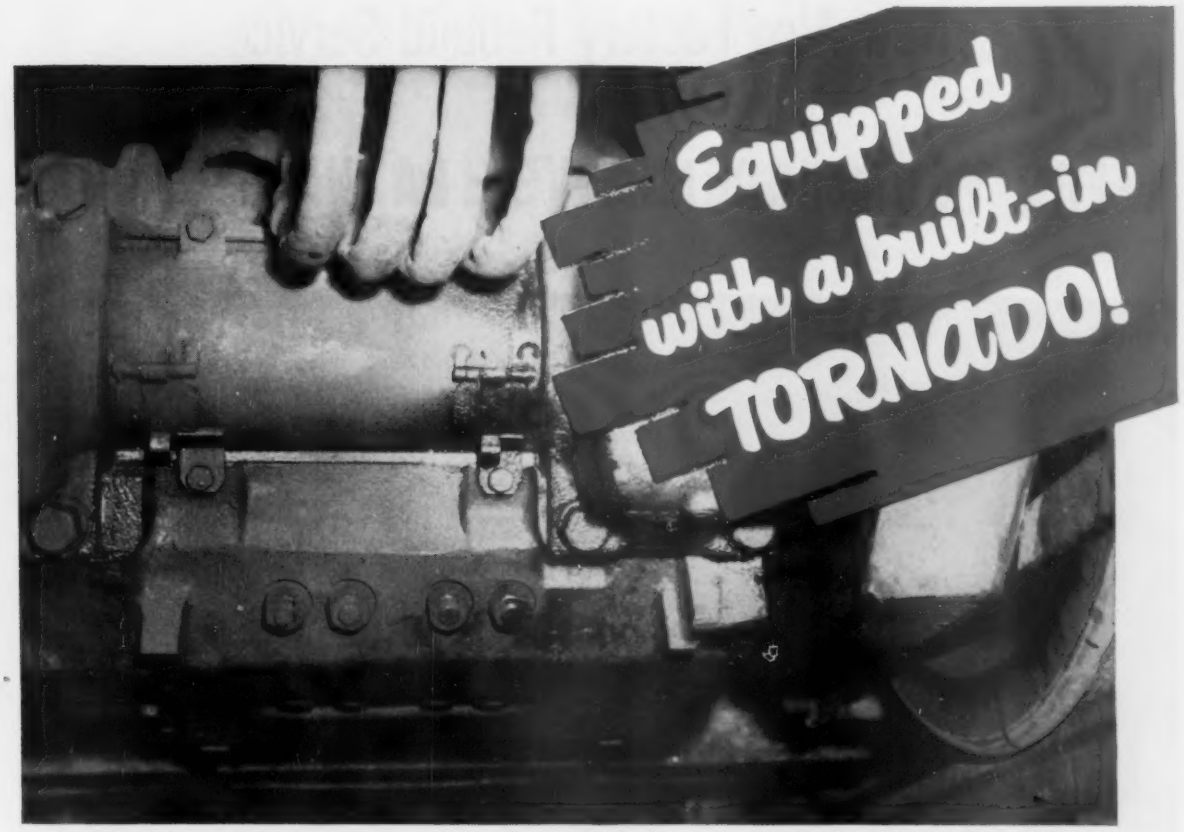


Just as this up-to-the-minute Diesel typifies the advancement in locomotion, so also "U. S." electrical wires and cables typify leadership in their field, as they have for 68 years.

US RUBBER

UNITED STATES RUBBER COMPANY

ELECTRICAL WIRE AND CABLE DEPARTMENT • ROCKEFELLER CENTER, NEW YORK 20, N. Y.



That's the way a traction motor cable might describe a diesel electric locomotive. The cable gets sand, ice crystals, snow, water, dirt and debris blasted at it by train suction. The cable is subject to constant vibration and swaying in extremes of temperature both summer and winter.

No wonder, then, that those concerned with diesel locomotive availability insist on the highest quality cable available. That's why the sales curve for Simplex Diesel Locomotive and Traction Motor Cable is going up so steeply. The word has gotten around that you can depend on Simplex Cables. They will be in there pitching long after less rugged cables have been replaced.

Simplex Diesel Locomotive Cables are made to keep locomotives on the road earning money, not in the shop being rewired. If you have any doubt about the ability of your present cable to "take it," try Simplex Diesel Locomotive Cables. You will be surprised and pleased with the service you get from them.

Want to know more about these tough, rugged cables? Your Simplex representative will be glad to tell you about them.

Simplex **DIESEL LOCOMOTIVE CABLE**

SIMPLEX WIRE & CABLE CO., 79 Sidney Street, Cambridge 39, Massachusetts

...Helps You Save On Equipment, Overhead, Manpower

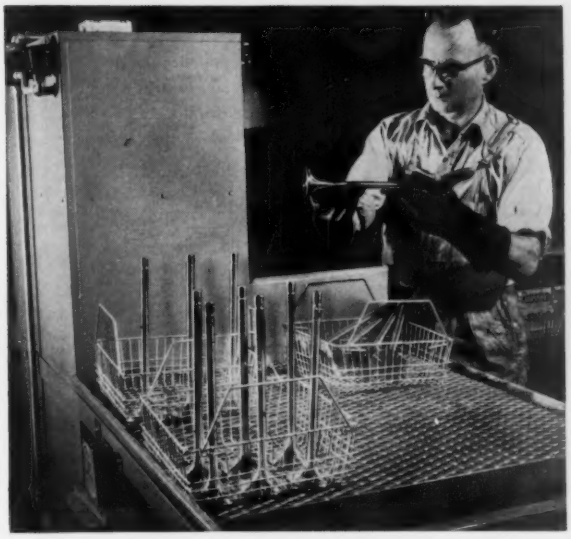
Alco's integrated Factory Rebuild Service at Schenectady, N. Y., has been established in response to two current needs of U. S. railroads.

FIRST is the need to maintain diesel-electric locomotives in top working condition, top earning condition longer and with less time out of service. Factory Rebuild Service meets this need through:

1. **Full use of the same machines, tools and inspection procedures used in volume production of new Alco diesel-electric locomotives.**
2. **Original manufacturer's engineering experience—plus latest manufacturing techniques.**
3. **Genuine Alco Renewal Parts—with full warranty.**
4. **Skilled craftsmanship and close quality control—for maximum customer protection.**

SECOND is the need to cut the high cost of equipment and other overhead items required for on-line repair. Factory Rebuild makes this possible through offering a complete service—repair, rebuild and modernization not only of components but of entire locomotives as well.

Ask your Alco locomotive representative for full details on this new Factory Rebuild Service in terms of your own operations, *your own present repair costs*, and the items of modernization applicable to your Alco equipment.



THOROUGH INSPECTION from valve stems to superstructure—truck frames to traction motors, assures that repaired, rebuilt, or modernized locomotives leave Alco Factory Rebuild Service meeting original manufacturer's *new-equipment standards.*

GENUINE ALCO RENEWAL PARTS—incorporating latest design features and backed by full warranty—add the final touch to the fast, economical yet painstaking service that builds years of extra life into locomotives and components.

LOCOMOTIVE COMPANY Sales and Service Offices in Principal Cities

INCENTIVE

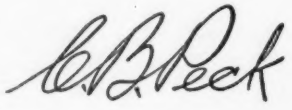
"We, at Lincoln Electric, have looked upon incentive in industry as a philosophy. We have regarded it as a tool for the sole purpose of giving a man an opportunity to develop his ultimate potentiality." So said Russell J. Van Dame, controller of the Lincoln Electric Company, in a recent talk before the Akron, Ohio, chapter of the National Association of Cost Accountants.

This philosophy touches the very heart of human relations—in industry technically called "employee relations."

Many incentives could be listed which influence human action and human relations. Those most commonly thought of in connection with relations between employees and employer have to do with some economic advantage sought by the employees. It is sometimes erroneously assumed that such incentives are the only ones which have any influence on the performance of employees. But that is not true. It may be questioned whether the unrest which has been a dominant factor in industry since the early 1930's was based primarily upon dissatisfaction with wages and working conditions. A good case can be made for the thesis that the underlying cause was frustration of the normal human desire of employees in the ranks for recognition of the value of their contribution to the success of business enterprises.

Corporation directors are liberal in their recognition of the value of economic incentives as factors in inspiring top executives to utilize their talents to the utmost in the interest of the corporation. There is no thought here to question the justification of such action. The question which it seems should be raised is why do business organizations overlook the fact that every employee is susceptible to the appeal of incentives and that they are by no means always synonymous with costly outlays by the company.

The complete lack of recognition of the contribution of employees in the ranks which many companies have accorded during the past generation has created a sense of frustration and dissatisfaction on the part of employees which has made them ripe for the kind of appeal—demagogic in some cases—which has aligned employees and managements in hostile camps. Incentive as a philosophy which encourages the individual to develop his full potentiality is an ideal within which resides the possibility for the restoration of satisfactory industrial relations—that is, decent human relations in industry.



EDITORIALS

Motive Power from the Atom

An engineman climbed down from the cab of a gas-turbine-electric locomotive and looked back up at his charge with justifiable pride. In answer to questions from this reporter, he said, "Yes, it's the latest thing. Probably the next will be atomic power."

In this day of rapid scientific development, people are prone to accept ideas as accomplishments, before designers can get them onto the drafting board. To the engineer, the path from conception to reality is a long hard climb in which there is little glory since the public has already accepted the end result.

A first attempt to design an atomic-powered locomotive has been made at the University of Utah. A summary of a report on this design is published in this issue of *Railway Locomotives and Cars*. It is properly called a feasibility study, and the designers are disarmingly frank in writing into the specifications requirements of equipment which in themselves are beyond the realm of accomplishment. It is necessary for the reader to realize that the report represents the best thinking up to now—to differentiate between the idea and reality and draw his own conclusions as to when he may see such motive power on the rails.

Probably the greatest hurdle to clear is the question of contamination. Meticulous care must be taken to avoid radio-activity in the operation of stationary reactors. A leak in the locomotive reactor, with its 40,000 welds might not allow any of the "soup" to get outside the locomotive, but it could render the locomotive unapproachable. A wreck or sideswipe which might break the reactor would apparently necessitate building that section of the road somewhere else. Experience indicates that a reactor out of control would not become an atomic bomb, but would result in a distribution of fission materials.

From a mechanical point of view, the reactor heat exchanger appears very small and it seems somewhat doubtful that one sufficiently large could be contained within the clearance diagram. Since the turbine would become radioactive, a turbine which could run without maintenance is desirable and perhaps essential. Such a thing on a locomotive is difficult to conceive.

To the operating man, the locomotive is a big one which would be used in preferred service. This means it would have to be subsidized by other motive power which must be idle when there is no work for it. To be sure the diesel was similarly subsidized, but the fact should be considered in the study of economics.

All this is not to say we shall never have an atomic-powered locomotive. We may, but the diesel went into service in this country in 1924 and the gas turbine has been some 12 to 14 years in the making. Relatively their problems seem simple.

Railway Freight-Car Inspection a Big Job

The magnitude of the task confronting railroads and railway car men inspecting and repairing freight cars, transferring loads when necessary and expediting the movement of all freight cars at interchange points throughout the country is not always fully appreciated. Take the Chicago gateway, for example, where the tremendous volume of business handled in 1953 amounted to 4,046,022 loaded freight cars interchanged, or an average of over 11,000 loads each day of the year counting Saturdays, Sundays and holidays. Even the current reduction in weekly car loading of about 12 per cent in the first quarter of 1954 leaves this a major task and service to industry and the nation.

Records of the Chicago Car Interchange Bureau give a clue to past accomplishments, current trends and certain details which need more attention. For instance, the fact that one loaded car of each 131 cars interchanged at Chicago in 1953 had to be shopped, as compared with 163 cars during the previous year, suggests some lack of inspection or maintenance which is certainly not being made up on most roads so far this year. The Chicago record also showed a slight increase in load transfers, shifted loads and cars not loaded in accordance with AAR rules. The appropriate remedies are self-evident, but need constant re-emphasis.

At Chicago in 1953, however, improvement was made in the number of cars rejected by receiving roads on account of being in bad order or not fit for loading from 1,083 in 1952 to 856 in 1953; empty hopper and gondola cars delivered in interchange with drop doors open or not properly secured reduced from 6,325 to 4,905; out of 2,332 car loads of perishable freight, shopped for repairs in 1953, 2,287 loads or 98 per cent reached destination as intended, truly a commendable record, as compared with earlier years.

Some lessons may be learned from the record of cars unloaded at a large Chicago produce terminal during 1953 after registration of lading damage claims: out of a total of 370 cars, 120 were found without defects; 120 had defects in siding; 62 in doors; 10 in ceiling boards and 9 showed evidence of cinders dropping through ceilings. The inspection of 145 cars with damaged potato loads showed only 104 cars without mechanical defects; 19 defects in siding; 12 in ceilings; 5 in doors. Potatoes are

among the less easily damaged food products, but the figures quoted suggest the need for greater care in checking the mechanical condition of cars offered for loading this and other commodities to be shipped by rail, major emphasis being placed on car siding, ceilings and doors, in that order.

Shop Centralization—Is It Going Too Far

No one doubts that one of the principal benefits of the change-over to diesel power has been the reduction and consolidation of outlying shops and facilities. But one railroader who has originated many good ideas in the past wonders if the overall general policy of centralization of repairs has not gone too far, and he raises some interesting questions that deserve investigation and answer before anyone can say with reasonable certainty that he is wrong.

The first question is just how much added inventory is necessary to keep the pipe lines full to the outlying shops? How many spare pistons, liners, heads, rods, wheel sets, traction motors, etc., must be tied up to take care of transit time? Is it not possible that the money tied up in this added inventory is greater than what would have to be invested in a few extra machines at branch shops, or to equip servicing points to do their own parts overhaul for making heavy repairs on units operating in their vicinity? There are, of course, some heavy machines that can be justified only for a central shop. But is there not a lot of lighter machinery that can be installed at both the central and the branch shop without too much cost?

And what about the role of human nature? When a master mechanic overhauls his own locomotive, he is only going to repair or renew that which is economically justifiable so that he can stretch his budget as far as possible. When he sends his unit to a central shop, he is tempted to get everything done that he can. That comes out of somebody else's budget. A similar temptation exists on the other end. The boss of the central shop is naturally interested in production, and consequently a little less interested in seeing that everything is done just right than the man who has to live with that locomotive for the next year or more. The results of these two opposing interests may cancel each other out, or the disadvantages may be cumulative.

Another factor that we may be overlooking is the educational value of having the running-repair men see the equipment torn down once in a while. From this they can gain a better understanding of the functioning and relationship between different parts. They can also see what happens when certain necessary jobs are neglected or improperly done. This is true even though the running-repair man won't be doing the overhaul or major inspection work. Being at the same shop, he will see far more of the end results of his work—good or bad—than if the locomotive were torn down hundreds of miles away at a central point that he probably never sees.

NEW BOOKS

ABC's of Air Brakes. By C. M. Drennan. This is the first of three volumes based on the "Chalk Talks" of the author which have been a feature in the education of enginemen, trainmen, and maintenance employees in the functioning of air-brake equipment for about 30 years. The air brake operates on certain fundamental principles. Mr. Drennan has mastered the art of leading the student, step by step, through the presentation of these principles and then through their applications a step at a time so that the student never becomes confused by having to master more than a single concept at a time. The present volume deals with the fundamentals of air-brake design, construction and operation as applied to railway cars and locomotives. Section I is on General Railway Train Brake Control, with subsections on friction and braking ratio, freight-train brake control, and passenger-train brake control. Section II goes into such parts as pistons, valves, electric controls and other components of equipment and explains their various functions and operations. Section III, an Air Brake Dictionary, defines words, terms and phrases used in connection with air brakes by railroad men, many of which have meanings different from those found in a regular dictionary. The dictionary aims at more consistency in definitions and applications of terminology since many air-brake terms are used with different meanings in different sections of the country. The first two sections contain 70 of the "Chalk Talks" diagrams, and a "Chalk Talks" quiz follows each unit of study. Questions are framed so that they can be answered by checking "Yes" or "No," and correct answers are available for comparison.

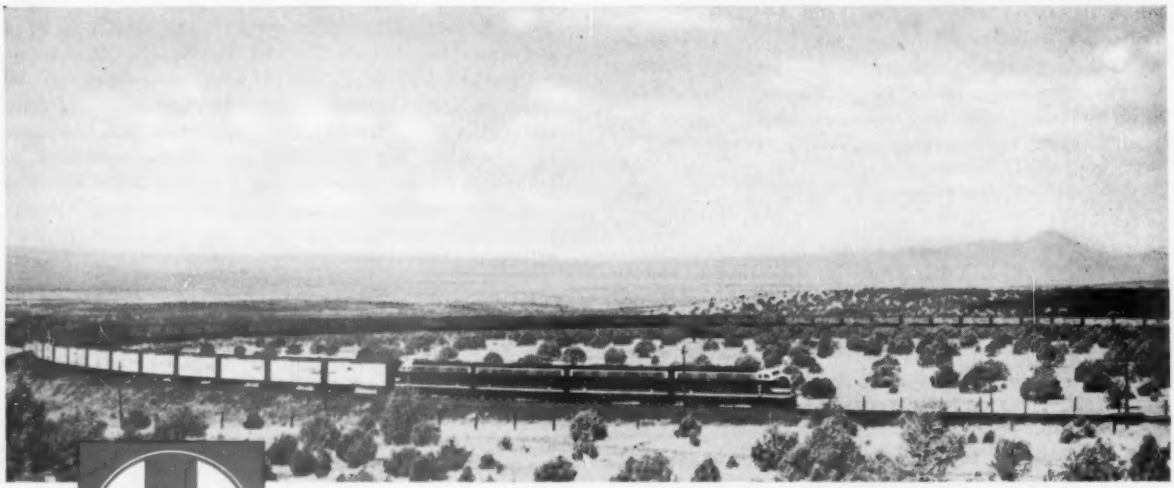
Simmons-Boardman Publishing Corporation, 30 Church street, New York 7. Price $4.75.

ASME Handbook of Metals Engineering-Design. Edited by Oscar J. Horger, chief engineer, Railway Division, Timken Roller Bearing Company. This book, prepared by Mr. Horger and other recognized authorities, is the result of a survey in 1941 by the Metals Engineering Division, ASME, which showed the need of the mechanical engineer and designer for a ready reference to the properties and characteristics of metals. It discusses the essential properties which need to be evaluated in the selection of one material over another. Analytical methods supported by laboratory experience replace older empirical formulas; shape and geometry are shown often to be of greater significance than any other factor governing strength of finished product, and economic aspects are considered in the determination of one method of processing over another. The book is made up of 43 sections in six parts—Selection of Material, Mechanical Properties of Metals in Design, Mechanical Factors Influencing Corrosion, Metallurgical Factors in Design, Processing Considerations in Design, and Design Procedures.

McGraw-Hill Book Company, 330 West 42nd street, New York 36. Price, $10.

Now SATCO-LINED JOURNAL BEARINGS

MAKE NEW RECORDS IN FREIGHT SERVICE, TOO!



Santa Fe

Santa Fe Puts 1000 Refrigerator Cars on LOW COST SATCO—with only 14 removals (including wheel changes) in 26,000,000 miles

Putting Satco-lined journal bearings on freight cars costs only about $3.00 more per car. That's a very low price for the premium performance you can get.

On the Santa Fe, in November, 1952, 1000 "reefers" were put on Satco – part of the big progressive improvement program for "America's New Railroad." After one full year (including one of the hottest summers on record) these 1000 reefers had accumulated 26,000,000 car miles with a total of only 14 bearing removals. Some of the 14 removals had to be made because of wheel changes that require new bearings whether the old ones have worn or not. *And the Santa Fe is still getting the same top quality performance.*

Why Satco Bearings are Better

Satco proved itself on passenger cars and locomotives years ago. Now it's making records in freight service, too. The reasons: Satco has a melting point 150°F. higher than standard AAR babbitt. That means a harder and stronger bearing at high temperatures. In the laboratory and in service, Satco-lined bearings have actually been run under full load at temperatures of 400°F. and over, without ill effect. When you consider that normally the bearings operate at temperatures about 100°F. above atmospheric, the big extra margin of safety you get with Satco is apparent.

More Satco for the Santa Fe

This extensive freight car application has been so satisfactory that now the Santa Fe plans to put 500 box cars on Satco-lined bearings. Other roads are freight-testing Satco, too, with hopper cars, cement cars, and other types already in service.

Ask us to give you the facts and figures about Satco lining metal and what it can do to improve your freight car performance. Just write to Magnus Metal Corporation, 111 Broadway, New York 6; or 80 E. Jackson Blvd., Chicago 4.

MAGNUS

Solid Bearings

Right for Railroads
...in performance ...in cost

MAGNUS METAL CORPORATION *Subsidiary of* **NATIONAL LEAD COMPANY**

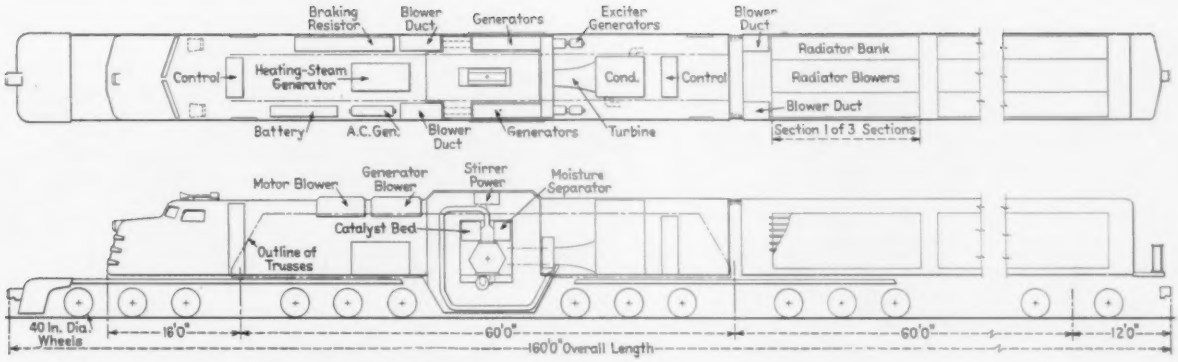


Fig. 1—Phantom plan and elevation of the proposed atomic locomotive showing arrangement of equipment.

Design for an Atomic Locomotive

A calculation made to show what it would take to build a locomotive which could use nuclear fuel.

WHAT it would take to build an atomic powered locomotive is outlined in the following summary. The complete report was presented by Dr. Lyle B. Borst, director of research, University of Utah, at a meeting of the Atomic Industrial Forum, held in New York, March 15-16, 1954.

The locomotive design was worked out by graduate students at the University of Utah, assisted by members of the faculty and representatives of manufacturers and railroads.

An atomic powered locomotive has been found to be technically feasible. It would be a 7,000-hp unit, having 12 driving axles and a total length of 160 ft.

The reactor would be of the water boiler design 2 ft. by 3 ft by 3 ft, having an output of 30,000 kw of heat in the form of steam at 250 psi. Contaminated steam would be used to operate a conventional condensing turbine, the heat being rejected through finned radiators to the atmosphere.

Power transmission would consist of geared generators and conventional traction motors.

Electric-locomotive performance would be achieved because of the overload capacity of the reactor. A short-time output of 9,000 to 12,000 hp could be attained.

Economic studies are necessarily incomplete in the absence of fuel costs (i.e. the price of U^{235}). If U^{235} costs less than $7 per gram, the locomotive would compete with present diesel units under average present operating conditions. If U^{235} costs were less than $25 per gram, the locomotive could compete with equivalent diesel power under optimum conditions of load and service.

Problems of health and public welfare are considered technically soluble, although the exact arrangements have not been detailed.

Duty and Specification

The only real economic incentive for atomic power comes from a possible reduction in fuel costs. This is particularly true of the first few locomotives. At a future date, if atomic units replace diesels, there may be further economies due to the retirement of fueling

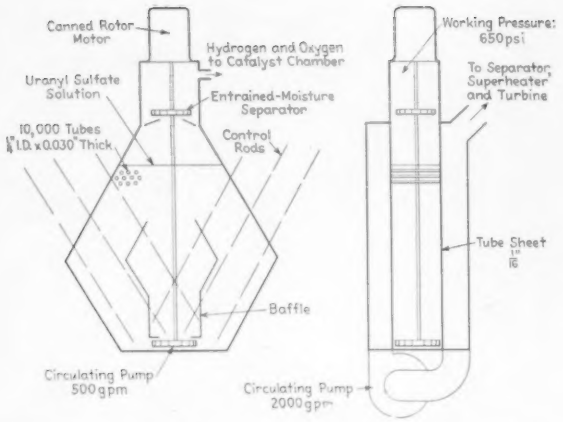


Fig. 2—Longitudinal and transverse sections of the reactor and heat exchanger for producing 160,000 lb of saturated steam per hour at 250 psi.

equipment in the same fashion that diesels have retired extensive watering and ash-handling facilities. Atomic units will require infrequent refueling, which must be done at an elaborate central facility.

An important characteristic of a reactor is that its output is not proportional to its expense. A 1,000-kw reactor may require 5 ft of shielding whereas a 10,000-kw reactor might require 5.5 ft. Each must have about the same control system and safety devices. The initial quantity of fuel required might differ by as much as 10 per cent. The principle system proportional to power rating is the heat exchange system, and its cost may increase rapidly with output. The locomotive proposed is, therefore, as large a unit as would appear to find use in present railroad practice. Reactor and shield weight can probably not be reduced much below 400,000 lb. When placed on a chassis and provided with necessary auxiliaries, it is bound to be a large and heavy locomotive.

Maintenance costs associated with the reactor are likely to be low. Maintenance within a reactor shield is prohibited by the radioactivity. The reactor must therefore be designed with such care that failures within the shield are extremely improbable. In the event of a failure of the reactor, the locomotive can be expected to be out of service for months and perhaps years. Other equipment: turbine, heat exchanger, generator and motor would be of conservative conventional design and would entail normal maintenance. The turbine would presumably require less maintenance than reciprocating diesel engines of comparable power.

Because of its size and cost, the atomic locomotive will seriously lack flexibility. In order to compete, it must haul heavy loads at high speeds with short turn arounds.

In principle, it should be capable of simple operation. There is no reason why during normal operation a steam pressure gage, ammeter and throttle cannot be the operating instruments.

Reactors are capable of virtually infinite power output. They are limited in practice only by the requirement of heat removal. If the proper heat extraction and energy conversion system can be developed, the atomic locomotive should be capable of electric locomotive performance.

TABLE I—OPERATING CONDITIONS

Reactor heat generation (continuous), kw	30,000
Steam pressure (saturated), psi	250
Reflector temperature, deg. F	405
Soup temperature, deg. F	460
Exhaust pressure, in Hg. (3 psi)	6
Saturation temperature, deg. F	140
Steam flow, lb./hr.	120,000
Turbine power (continuous), hp	8,000
Efficiency (estimate), percent	25
Auxiliary power, hp	1,000
Power for traction, hp	7,000
Turbine speed, rpm	6,000
Generator speed, rpm	1,000
Heat to radiators, Btu/hr	75,000,000
Water flow through radiators, gpm	5,000
Air flow through radiators, lb./hr.	10,000,000
Refuel	3 to 6 times yearly

The continuous duty power selected in the proposed design is 7,000 hp, to compare with four 1,750-hp diesel freight units. An output of 10,000 hp or higher could probably be available for short-time duty. A conventional condensing steam turbine was selected as the prime mover, geared to four a-c generators. The steam pressure conditions selected were 250 psi saturated (superheat is quite possible) and 3 psi exhaust pressure.

Twelve motor-driven axles give a reasonable wheel arrangement. Using an axle loading of 60,000 lb, the complete unit can weigh 720,000 lb. Motor ratings for continuous service are then 600 hp per axle, about equal to the Union Pacific gas turbine units.

Permissible dimensions accepted for design are 60 ft between truck centers, 10 ft widths, 16 ft height above rails, and a 6-in. clearance above rails. Present plans call for a trailer to carry the condenser cooling radiators.

General Description

The locomotive as presently visualized is shown in Fig. 1. It consists of two units having an overall length of 160 ft. The traction unit would lead, the heat-exchanger unit trailing. This order might be reversed if desired.

Of this total installation, the power is derived from a reactor vessel measuring about 1 ft by 3 ft. This reactor (including pumps, steam separator and recombination system) is surrounded by a massive shield 4 ft thick weighing approximately 400,000 lb.

The turbine receives steam through a spiral steam line (to prevent leakage of neutron and gamma ray radiation), and operates on slightly radioactive steam: The exhaust steam is condensed in a tubular condenser, shown extending to the top of the cab. Condensate is pumped back into the reactor. Condenser water is pumped to the second car and then through high duty finned radiators where the heat is rejected to a large stream of cooling air. The turbine would be geared for generators on both sides of the cab. The generators and gears would constitute part of the reactor shield, and would not contribute additional weight to the locomotive.

The shield would constitute the center panels of a heavy-duty bridge truss which would transmit its weight to the traction assemblies.

Auxiliaries such as train-heating steam generator, dynamic braking system, motor cooling blowers, auxiliary a-c generator, etc., would be located in appropriate positions.

Figs. 3 and 4 compare the anticipated performance of the proposed unit, designated X-12, with that of steam, diesel and gas-turbine units of comparable ratings.

LOCOMOTIVE TYPE	WHEEL ARRANGEMENT	NO. OF TRACT. MOTORS	NOMINAL HP RATING AT GEN. FOR TRACTION	WEIGHT IN LB APPROX. ON DRIVERS	WEIGHT IN LB APPROX. PER DRIV AXLE	MAX. CONTINUOUS TRACTIVE FORCE AT DRIVERS	MAX. CONTINUOUS TRACTIVE FORCE AT DRAWBAR	% ADHESION USED
STEAM 4000-4024	4 – 8 – 8 – 4 (132')		6670 AT CYL.	540,000	67,500	129,950 (135,375 AT CYL.)	128,600 AT 10 MPH	24.0
ATOMIC X-12	B – D + D – B / 0-4 – 8 – 8 – 4-0 (100')	12 74/18	7200	720,000	60,000	157,500	156,470 AT 14.1 MPH	21.9
DIESEL (4-FT'S) 1400-1496	4 (B-B) / 4 (0-4-4-0) (200')	16 62/15	6000	992,000	62,000	160,000	158,650 AT 11.5 MPH	16.0
GAS-TURBINE 51-60	B-B – B-B / 0-4-4 – 4-4-0 (85')	8 74/18	4500	552,000	69,000	105,000	104,270 AT 12.9 MPH	19.0

Fig. 3—Characteristics of the proposed atomic locomotive compared with those of existing types of steam, diesel-electric and gas turbine-electric locomotive.

TABLE II—REACTOR CHARACTERISTICS

Power, kw	30,000
U^{235}, lb	19.8
UO_2SO_4 weight, lb	30.6
Water, lb	535
Vessel thickness, in.	11.85
Total volume of 10,000 tubes (0.315 in. o.d.), cu ft	5.3
Net volume of 10,000 tubes (¼ in. i.d.), cu ft	3.36
Weight moderator in tubes, lb	178
Fraction of moderator in tubes	1/3
Volume of 176 kg. soup, cu ft	7.17
Distance between tubes, in.	0.134
Tube surface, sq. ft	800

The Reactor

The vessel to contain the liquid fuel, which is an aqueous solution of uranyl sulphate, must be able to withstand high temperature and pressure, corrosive liquids, and very intense radio activity. It must be constructed so that it is absolutely leak proof, and it must be made of a material whose nuclear properties will not adversely affect the fission chain reaction. High grade stainless steel fulfills the requirements for the structural material.

The shape chosen to contain the liquid fuel, or "soup" as it is frequently called, is a hexagonal slab. Adjacent to each of the two hexagonal faces is a water reflector. The two reflectors are connected by 10,000 heat transfer tubes which perforate the soup vessel. The water which circulates through the tubes and reflectors serves a dual purpose since it is the source of the steam for the turbine and an essential part of the nuclear reactor.

The vessel extends above the hexagonal volume occupied by the soup to provide space for expansion, moisture separation, and a recomposition chamber for the hydrogen and oxygen resulting from radiation decomposition of water. In the soup volume portion of the vessel are the soup circulation equipment and the control rods. Circulation of the soup may be accomplished by a system of baffles and a circulation pump. The control rods which consist of sheets of material of the appropriate nuclear characteristics, are perforated to maintain circulation. Pertinent data appear in Table II.

Since the soup will be very radioactive, corrosive, and at a higher pressure than the reflectors, double wall construction of the soup vessel is proposed to satisfy the leak-proof requirement. Air or water can be passed continuously through the space between the walls and

CURVE	LOCOMOTIVE TYPE	NOMINAL HP RATING AT GEN. FOR TRACTION	UP SERIES
1	STEAM	6670 AT CYL.	4000-4024
2	ATOMIC X-12	7200	
3	DIESEL (4-FT'S)	6000	1400-1496
4	GAS TURBINE	4500	51-60

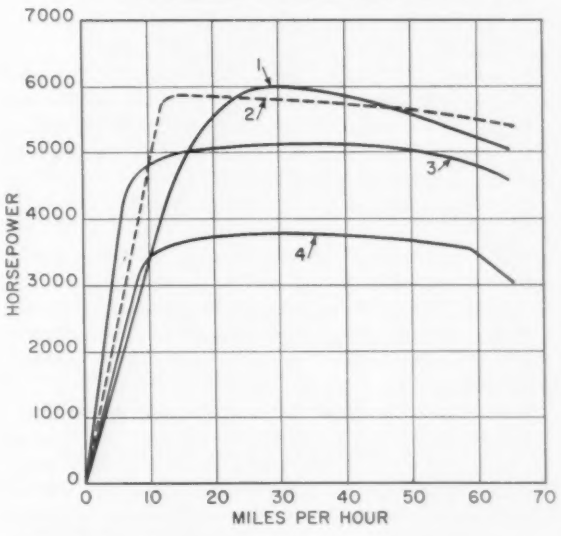


Fig. 4—Speed-horsepower curves for Union Pacific types of steam, diesel-electric and gas turbine-electric locomotives and for the proposed atomic locomotive.

then through a radiation detection device, where an increase in radioactivity would indicate a leak in the inner wall. Then remedial steps could be taken before a leak developed in the outer wall (which would result in contamination of the turbine-generator system). Note that this will require 40,000 welds to install the 10,000 tubes, each of which will consist of two concentric stainless steel tubes of 0.015 in. wall thickness.

The reactor will be located at the center of a 10-ft by 15-ft by 15-ft shield and oriented so that the hexagonal

TABLE III—TURBINE CHARACTERISTICS

1.	Power requirements:	
	a. Output, hp	8,000
	b. Overload output, hp	10,000
2.	Throttle conditions:	
	a. Saturated steam, psi	250
	b. Temperature, deg. F	400
3.	Exhaust:	
	a. Back pressure, in Hg. (3 psi)	6
	b. Temperature, deg. F	140
	c. Moisture content, per cent	21
4.	Operate as contaminated unit	
5.	Speed, rpm	6,000
6.	Dimensions: Unit must be placed in a space 10 ft wide by 15 ft high with minimum length.	

faces are perpendicular to the direction of motion of the locomotive. This results in a distance of 4 ft from the outer face of the reflector to the face of the shield adjacent to the cab.

The shield material will be approximately ½ steel and ½ hydrogenous material of about unit density which will give a total weight of the order of 400,000 lb. The nuclear requirements are that the high and low density materials appear in alternate layers.

To minimize the wreck hazard, it is proposed that the shield be designed as a series of containers, then each steel layer of the shield would be a potential container if the soup vessel should rupture.

Nuclear Properties: The proposed nuclear reactor is a homogeneous thermal reactor. Uranium-235 is the fissionable material; hydrogen, in the form of water, is used for the moderator, reflector, and coolant.

The uranium, in the form of uranyl sulphate, is dissolved in the water moderator to give a homogeneous solution. The choice of this compound is based on its high solubility and the radiation stability of sulphate ions compared with other anions.

The moderator water will undergo radiation decomposition into hydrogen and oxygen at the rate of 32 gallons of water decomposed per second, when operating at full power. At this rate, 10 per cent of the moderator would be lost in 13 minutes operation at full power. Thus, the hydrogen and oxygen must be recombined and the water returned to the soup in order to maintain a constant moderator to fuel ratio.

When gases rise from the soup through the moisture separator, they will be pumped to a catalytic combustion chamber, recombined, and water returned to the soup. The rate of energy release from recombination will be 500 kw when the reactor is operating at full power.

By incorporating a trap for inert gases in the combustion chamber, the xenon-135 problem can be solved with the same piece of equipment.

Heat Transfer: The 10,000 tubes which perforate the soup present a surface of 806 sq ft. for heat transfer. For a temperature difference of 60 deg. F. this is reasonable for a forced convection system.

Since the circulation in the reflector is much too fast to permit separation of the steam and water by gravity, a steam separator must be included. A system in which the direction of the steam is changed to force the water out centrifugally should be adequate.

The heat produced after shut-down can be dissipated by continuing to operate the reflector circulating pump.

Control: The fission chain reactor is controlled by positioning sheets of a material which has a very high neutron absorption cross-section. Boron or cadmium steels are usually used. For this reactor, the control sheets must be perforated to permit circulation of the soup. In addition, the control rods must be designed so that a sudden change in acceleration, resulting from a wreck or other emergency, will cause them to fall into place by gravity.

Starting up the reactor is accomplished by removing the control rods. When the desired power level is attained, the rods are positioned to make the reactor critical which means the chain reaction is just maintained. Thus, starting is not instantaneous, but a certain length of time is required to attain the desired power. Similarly, when the control rods are inserted, a period of time is required for the chain reaction to die out, and it is necessary to provide for heat dissipation after shutdown.

Refueling: The build-up of fission products in the soup introduces an extreme radiation hazard in the refueling operating. This necessitates a highly specialized fueling station using remote control methods. A chemical processing plant may be included, or the spent fuel sent elsewhere for separation of the remaining U^{235} from the fission products.

Since the reactor can operate for a comparatively long time before refueling, the high cost of the fueling station will be offset to some extent by the need for possibly just one station.

The Turbine

The operating conditions that will be used in this discussion are listed in Table III. It would be desirable to find a method in which saturated steam was not used. A means of superheat might be achieved by utilizing the heat potential of the reactor shield. This would involve a system of elaborate piping throughout the shield, and such a proposal is not considered in this report.

Basing the design on a final moisture content of 21 per cent in the latter turbine stages, would cause excessive erosion of the blades of these stages. Some system making use of a steam separator might be examined in a future re-evaluation, but for the present report the conditions as stated is used in the design data.

Condensation: Since the turbine is about 25 per cent efficient, and since the input heat is 100 million Btu/hr, the turbine uses about 25 million Btu/hr. The remainder of the heat, 75 million Btu/hr, would be dissipated in the condenser.

The condenser would be arranged with the pipes running from side to side having a total width of six feet. The cooling water from the radiators would be piped into one side of the condenser, and removed on the opposite side, flowing horizontally through the pipes.

A feed pump at the bottom of the condenser would pump the return water to the reactor. This pump would have to be capable of pumping 250 gal per minute.

Heat Transfer

The feed water to the reactor-boiler must be a closed cycle. This means the degraded steam from the turbine has to be condensed before it is fed back into the reactor. The condenser is a horizontal-tube surface condenser, with water as the cooling liquid. The volume of cooling water required is so large, 300,000 gal per hour, that it must be conserved. Radiators, mounted on a second unit, will have to be used to cool the condenser

water by dissipating the heat to air. In a design based upon the General Motors' diesel radiator unit, one 60-ft car is proposed.

Electrical System

The transfer of the 7,000 hp produced at the turbine shaft, to the twelve locomotive axles is to be accomplished by an electrical system. It will consist of a double symmetrical, double-reduction gear set, giving a speed reduction of 6.25 to 1 from turbine to generator, four separately-excited d-c generators, and twelve traction motors, one driving each axle.

The generators are to be designed to fit a symmetrical spacing on either side in the rear of the reactor shield, two generators on either side, one above the other.

Contaminated Turbine

If a closed steam cycle is used, there is no reason why the turbine should not operate on steam generated within the reactor. Such steam will inevitably carry radioactivity and will contaminate the turbine. The level of radioactivity in the region of the turbine would not compare with the level within the reactor, so that no shielding has been shown in the drawing. Maintenance of the turbine will be rendered more difficult by the presence of contamination. The ideal design would call for a zero maintenance turbine.

Startup

Reactor accidents up to the present time have never occurred in a stably operating reactor. They have all occurred in connection with reactor start up. A reactor stably operating at full power, if properly designed, will respond to changes of operating conditions in such a way as to reestablish the initial conditions.

The establishment of a chain reaction is a tricky and time consuming operation. Reactor shutdown is simple. Rods of neutron absorbers are inserted and that is all there is to it. Reactor startup requires a trained and experienced operator in addition to high quality instrument and control systems.

Each reactor type has typical startup characteristics. In the case of the proposed reactor, startup should probably be comparatively quick and easy. In predicting the characteristics of the present locomotive, it would be unwise to assume that the locomotive could be ready for service in less than half an hour after a man went aboard.

During a run or at anytime when an operator is present, the reactor could be reduced in power to perhaps one per cent of the full power. Raising the power to operating power would be easy and quick. If the turbine were idling, the power required might be five per cent.

It is only when the locomotive is left in the yard unattended that the reaction must be thoroughly quenched with shut-off rods. Thereafter the chain reaction must be reestablished under rigid supervision.

Accidents

In the case of a wreck, the first and all important operation which must be carried out with absolute assurance is to shut the reactor off. Safety devices must be devised so that under any imaginable situation the chain reaction will be stopped.

The principal criticism of a reactor of the type described is that the fuel is liquid. In terms of safety a solid fuel reactor is superior to the one described. The fuel container must at all cost be kept intact! It is well guarded by a four-foot 400,000-lb shield, which can be constructed so as to safeguard the vessel. The whole assembly would be designed to withstand a shock of 20 g., but to safeguard the reactor in case of a wreck, the detailed design of equipment would require a high order of ingenuity.

TABLE IV—ANNUAL COST COMPARISON
10-YEAR AMORTIZATION

	Atomic	Diesel
Payment (16 per cent)	192,000	96,000
Repairs	50,000	50,000
Lubrication	3,000	10,000
Fuel (200 hr/month)	—	120,000
	245,000	276,000
		−245,000
		31,000

Maximum price of uranium to compete with diesel
31,000 − 3,000 = $10 per gram U^{235} ($4,500 per pound)

Economics

A comparison of the economic possibilities of the proposed locomotive with current diesel and steam practice must necessarily be incomplete because of the classified or secret status of the price of uranium. The present discussion will therefore be limited to developing a price for uranium which would make atomic power equivalent to diesel power. It is estimated that the atomic locomotive could be built for $1,200,000.

Estimates of the price of the locomotive have not included development costs.

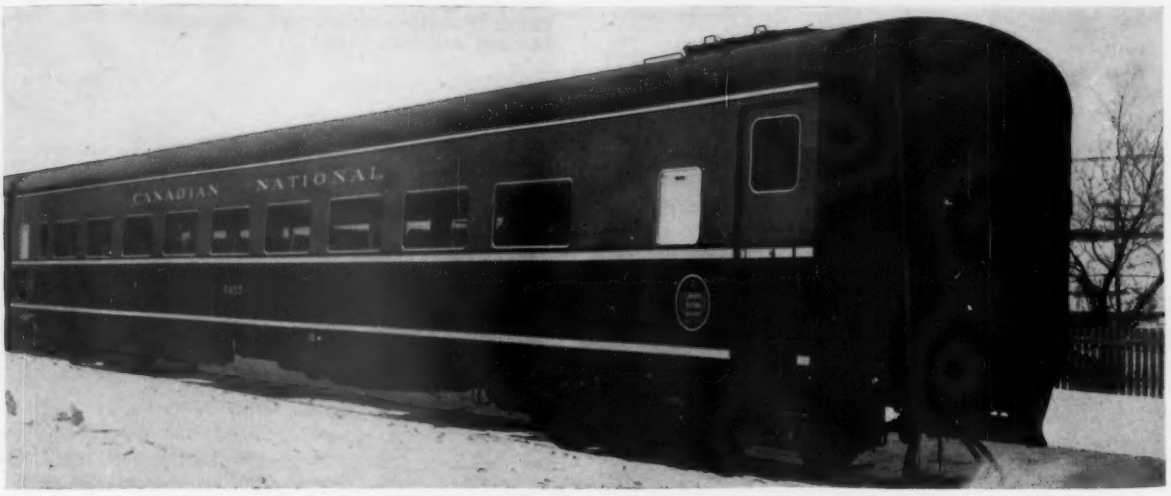
Water requirements should be negligible since the turbine and reactor system must be hermetically sealed to avoid release of radioactive materials.

Refueling might require two or three days once or twice each year. One hour to start the reactor after complete shutdown should be ample. Experience may well reduce each of these estimates.

Economies to be gained from atomic power must come from the cost of fuel. Successful competition with diesel operation will first come under conditions of a high duty factor. The duty to which the average diesel is put is equivalent to approximately 200 hours of full power operation per month. The price of fuel is initially estimated on this basis.

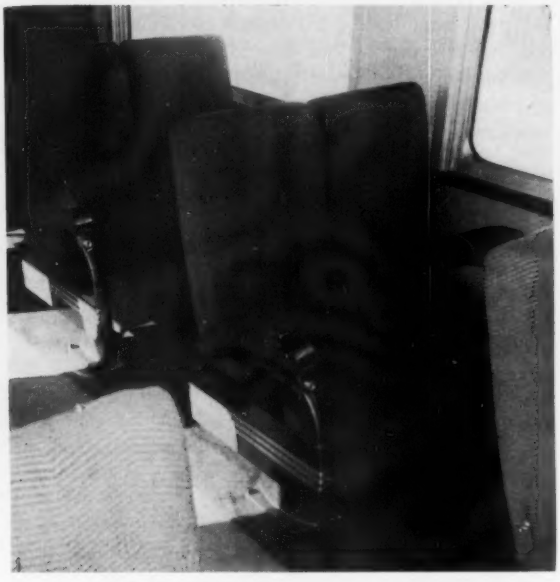
Amortization is assumed over a period of ten years. Financing is assumed to be based on 15 per cent equity money and 85 per cent equipment trust funds at an interest rate of 3.5 per cent. Taxes and insurance are assumed at 3 per cent of the purchase price. These charges are equivalent to a total annual charge of 16 per cent. On this basis annual costs are summarized in Table IV.

It is evident that the type of service to which the locomotive is put is a major economic factor. It must be used in heavy duty service where its power is fully utilized to give the highest equivalent uranium price. High-speed, high-power service is the combination which will first justify its use.



Canadian Car & Foundry Co. is building the coaches. The new CNR colors are black on the roof and below the windows, green from belt rail to plate, and gold stripes and lettering. The maple leaf in the emblems near the ends of the car are red.

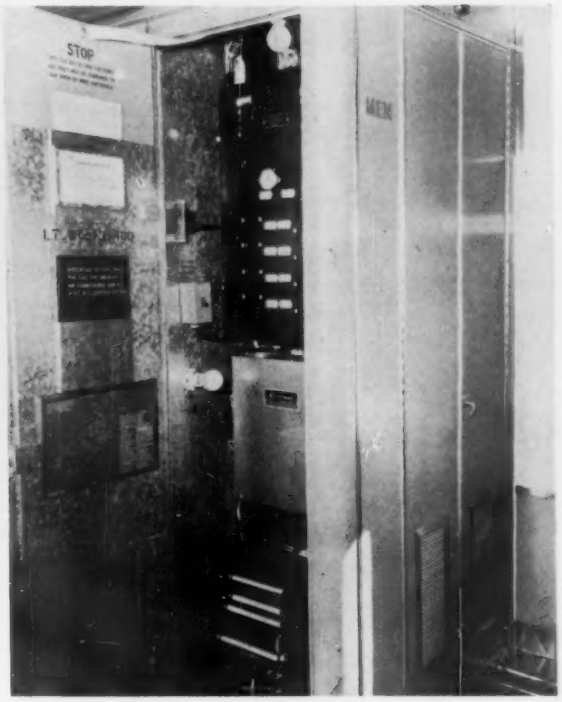
Looking toward the main passenger section from the smoking section of the Canadian National coach. The four color schemes use rust, green, brown and blue upholstery with matching linoleum floors. Seats have reclining backs, foot rests and rotating reverse. The recessed ash trays shown are in the arms of the seats in the smoking section.



Canadian National Spends $59 Million for New Passenger Cars

359 cars of 14 types are designed to improve service on all principal trains throughout the system. Canadian Car & Foundry builds the coaches; Pullman-Standard, the sleepers, parlor cars, diners and combinations.

A car shell ready for insulation and interior finish. Side sheets are stiffened with small horizontal angles.



Lighting switchboard, heating and air-conditioning controls, and lamp regulator. Electrical apparatus is accessible through double doors around the corner to the right.

THE Canadian National is now receiving from two builders, one in Canada and one in the United States, passenger-carrying cars which, when all deliveries have been completed, will have amounted to 359 cars of 14 types. The Canadian Car & Foundry Co. is building 218 coaches all of the same type. This is the largest order for passenger-train cars ever placed with a builder in Canada and the largest ever placed in North America for cars of a single type. The Pullman-Standard Car Manufacturing Company is building 141 cars of 13 types, the number and weights of which are shown in a table. These are all various combinations of sleeping, parlor, lounge and dining accommodations. First deliveries are the 52 four-bedroom, four-section, eight-duplex roomette cars. There are 20 six-roomette, four-bedroom, six-section sleeping cars and 14 40-passenger dining cars. The remaining ten types, of which smaller numbers were ordered, are arranged to accommodate a variety of traffic conditions on various parts of the system.

The 218 Coaches

The overall length of the coaches is 85 ft. 4½ in. over the buffers; the maximum width, 9 ft. 11¼ in. over the side sheathing, and the maximum height, 13 ft. 6 1/6 in. Each coach seats 80 passenger and weighs, light, 131,000 lb. There is a vestibule at one end only.

The interior walls are entirely without paint. Arborite, Panelyte or Dor-o-lam plastic-coated panels are applied to the ceilings, ends, and sides. These materials are readily cleaned with soap and water and do not require repainting. Four color schemes are being used.

Each coach has a smoking section seating 28, separated from the 52-passenger main section by a partition the wainscot of which is finished with plastic decorative panels and the upper portion of which is armorplate glass. The glass is decorated with etched horizontal bars adjacent to the aisle.

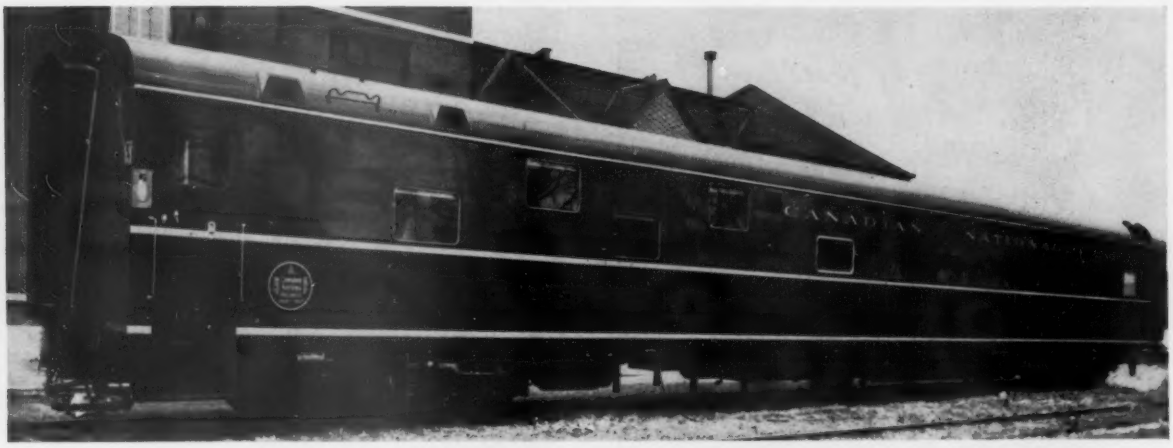
Each large side window gives visibility for two seats. The Adlake aluminum sash is glazed with a sealed unit consisting of a ¼-in. heat-absorbing, nonglare glass pane on the outside and a ¼-in. laminated safety pane on the inside, set in extruded rubber. Window sills are capped with the plastic decorative material. There are continuous baggage racks of aluminum. The side ceiling panels immediately above the racks are covered with stainless steel.

The Heywood-Wakefield and Econoliner seats, except those at the bulkheads, are reclining and rotating with foot rests. The arms of the seats in the smoking section have recessed ash trays. Seat cushions, backs and arm rests are foam rubber upholstered in Collins & Aikman textured wood frieze.

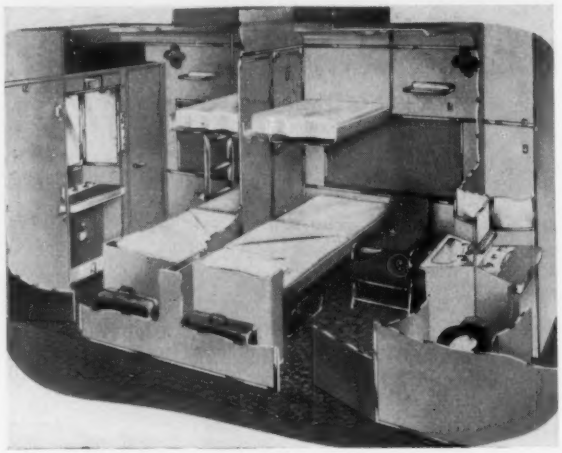
Car Structure

The car body structure is high-tensile low-alloy steel. The underframe, sides, ends and roof are built in jigs largely by welding and assembled to form the car shell by riveting. The center sills consist of two AAR sections, each weighing 31.3 lb per ft, with top flanges continuously welded and riveted to a Commonwealth steel platform and center-sill casting. This casting includes the buffer beam and draft-gear buffer pockets.

The side sills are 5-in. by 3 3/16-in. by ¼-in. rolled zees, and the side-sill chords 2½-in. by 2-in. by 3/16-in. rolled angles. The bolsters are double-web weldments. Cross-bearers are single-web pressings, and floor beams 4-in. 5.4-lb rolled channels, riveted to the side sills. The end sills are steel pressings.



A four-bedroom, four-section, eight-duplex roomette sleeping car.



Adjoining bedrooms can be arranged for double occupancy by removal of partitions between the berths.

A bedroom (left) made up for daytime occupancy.

The subfloor sheets are 16 gage; the floor stringers, light section zee pressings, and the flooring, 1-in. waterproof plywood. The top surface is 3/16-in. Marboleum.

The side frames are all-welded. Each side plate consists of two 3-in. by 2-in. by 3/16-in. rolled angles. Side posts are 3-in. zee pressings. The side sheets, spot-welded to the frame, are 12 gage. Both the carlines and purlines of the roof are 3-in. zee pressings. Roof sheets are 13-gage at the sides and 16-gage at the center.

Sides, ends, and roofs are sprayed on the inside with Flintkote to a thickness, dry, of 3/16 in. Insulation is Fiberglas. This is 2½ in. thick on the sides, ends, and floor and 3 in. on the roof.

Heating-Air Conditioning

The cars are heated by floor-level fin-tube radiation and overheat heat from coils built into the air-conditioning evaporator. Controls are divided between the Vapor and Minneapolis-Honeywell types. The Minneapolis-Honeywell controls utilize highly sensitive electronic thermostats. The radiation is from an antifreeze solution circulated through the fin tubes by motor-driven pumps and heated by steam passing through a pipe in the center of the radiator. The Vapor equipment is for modified Unizone heat, utilizing two regulators, Rador cycling thermostats and unit-fin radiation.

WEIGHTS OF CNR CAR TYPES BUILT BY PULLMAN-STANDARD

Number of cars	*Type of accommodations*	*Estimated weight, lb.**
52	4-bedroom, 4-section, 8-duplex roomette	138,500
20	6-roomette, 4-bedroom, 6-section	139,514
6	Parlor car, seating 34	129,389
6	5-bedroom, 10-roomettes	140,341
6	5-comp't. 3-drawing room	135,428
4	8-section, 1-bedroom, dining room, kitchen, pantry	137,353
8	2-comp't., 2-bedroom, buffet, lounge	127,713†
9	Buffet, parlor, dining section	135,918
6	Dinette-dormitory car, seating 26	130,175†
2	Parlor, buffet, dining section	132,047
14	Dining car, seating 40	142,170
6	10-section, 1-bedroom, buffet	136,691
2	7-comp't., kitchen, buffet-lounge	140,914
141		

*Includes 40,600 lb weight of two trucks.
†Includes 40,157 lb truck weight without generator drive.

Air conditioning is electromechanical. It is adjusted to supply approximately 25 per cent fresh air. The capacity is 8 tons. The cool-air duct is located above the center ceiling, the panels of which are the Multi-Vent perforated type. In the smoking section the entire ceiling is perforated. The side panels cover ducts through which about 12½ per cent of the air is exhausted from the car. Another 12½ per cent is exhausted from the toilets and the electric locker. The recirculated air passes through a grill in the low ceiling at the smoking-section end of the car where it mixes with the fresh air and is filtered. This arrangement prevents the smoke-laden air in the smoking section from feeding back into the main passenger section through the open partition between the two sections. The equipment is divided between the Frigidaire and Trane systems.

Water coolers are divided among Chase, Sunroc and Lundy. They are served by Everpure water chlorinators and filters.

Electric Power Supply

Electric power for air conditioning, lighting and auxiliary services is supplied by a body-mounted motor generator, driven from a car axle by a Spicer gear-and-clutch drive. The equipment is being furnished by Canadian General Electric, Safety, and Stone-Franklin. The General Electric set consists of a 24-30-kw. 140-volt dc generator directly connected to a 220-volt 22-hp 4-pole, 3-phase, 60-cycle induction motor operating at 1,750 rpm. The motor-generator set is equipped with an exciter directly connected to the main shaft, which eliminates the reverser switch. There are two 100-amp standby receptacles for receiving stand-by power, and two 100-amp battery-charging receptacles on each car.

The battery is a 114-volt, 57-cell, lead-acid type rated at 600 amp-hr at the eight-hour discharge rate. Each battery is made up of 19 three-cell hard-rubber molded containers. Batteries are divided between Exide and Gould-National.

General illumination in the body of the coaches is supplied by two rows of Luminator incandescent lamp fixtures with 40-watt, 115-120-volt dc lamps, on the car ceiling. The lamps are suplied directly from the regulated direct current power source. Lamps of the same wattage are used in the vestibule. In the toilets, the water-cooler alcove, the blind end, and in the electric lockers and alternating-current chamber the lamps are 25 watt of the same voltage. A 25-watt, 220-volt generator pilot light is in the electric locker.

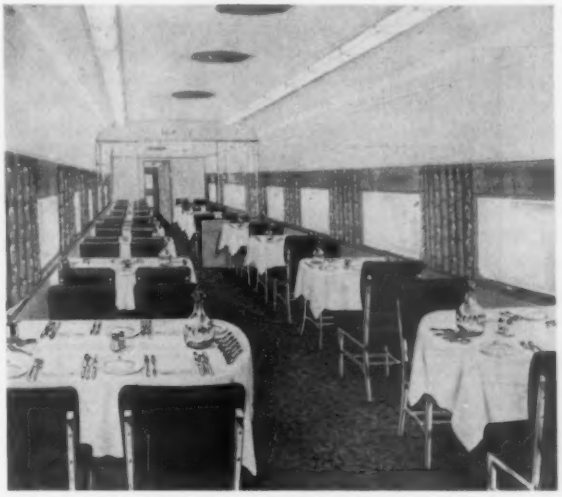
A feature of the Devoe lighting switch panel is the dimmer switch which halves the voltage on all the ceiling lamps in the main and smoking sections at one time by connecting each of two pairs of two normally parallel circuits in series.

Trucks and Brake Equipment

The four-wheel trucks are Commonwealth with outside swing-hangers and all coil springs. The wheel base is 8 ft. The 6-in. by 11-in. axles are fitted with Hyatt roller bearings on some of the cars and SKF bearings on others. Bearings are grease lubricated. The 24-in. center plate and 1-in. thick Thermoid friction pad between the body and truck plates tend to eliminate shimmy and loads on the side bearings. Fabreeka sound-deadening material is applied in the trucks.

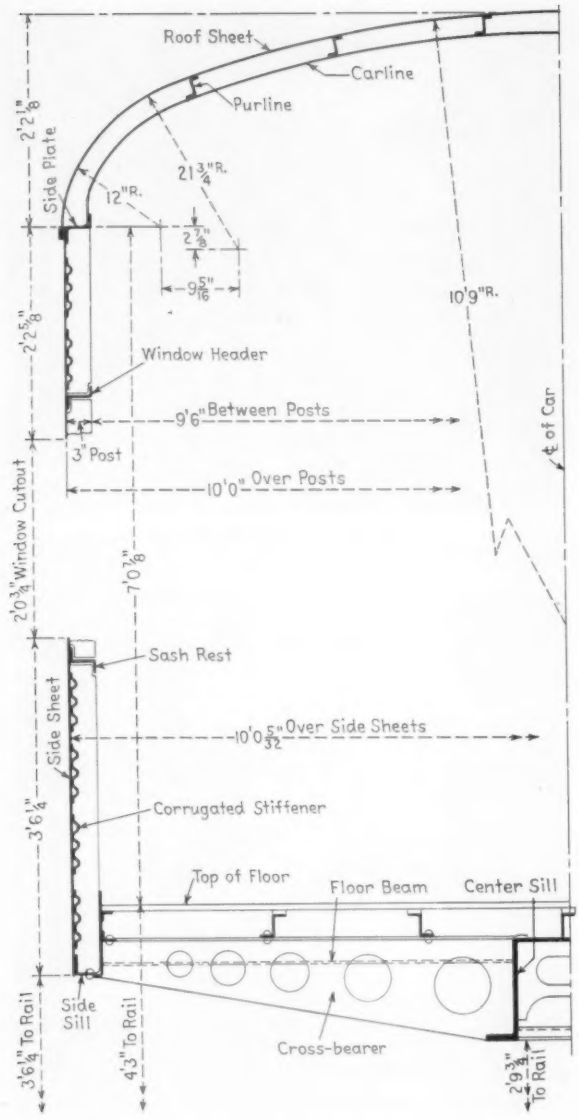
The trucks have unit-cylinder clasp brakes. There are

The dinette car seats 26 at a counter. A dormitory for six crew members is behind the counter.



The 40-passenger diner.

A parlor-car interior.



Cross-section of the cars being built by Pullman-Standard. Framing and exterior sheathing are high-strength low-alloy steel.

two 10-in. by 12-in. brake cylinders. The air brake is Westinghouse HSC equipment with D-22-AR control valves, but without the electrical feature. Hand brakes are Peacock. Couplers are Type E. Some cars are receiving Canadian Cardwell friction draft gears; others will be equipped with Canadian Waugh twin-cushion rubber gears.

Sleepers, Diners and Sleeper Combinations

Four of the car types being built by Pullman-Standard are sleeping cars with various combinations of facilities. One is a full parlor, one a dining car, and one a dinette car seating 26 persons at a counter. The remaining six types all include some combination of sleeping or parlor-car facilities with dining or buffet service.

The six dinette cars each has a kitchen about 13 ft long, a 50-ft dinette section with a back bar running the full length of the counter, and crew quarters for six, 13 ft long alongside a corridor at the end of the car. The four cars with eight sections, one bedroom, a dining section and kitchen each has a kitchen-pantry combination about 11 ft long and a 16-passenger dining room. Each of the nine parlor, buffet, dining cars has parlor-car seats for 20, a 16-place dining room and an 11-ft kitchen-pantry.

The parlor-buffet car includes two parlor sections seating 7 and 15, respectively, and an 8-seat dining section with an all-purpose buffet. There are two of these cars. There are six cars each with 10 open sections, one bedroom and a buffet, with men's and women's dressing rooms. Each of the eight two-compartment, two-bedroom, buffet-lounge cars includes a 36-ft lounge section seating 28 and an enclosed porter's section.

The two seven-compartment kitchen-buffet-lounge cars are arranged as business or special-purpose cars. Each accommodates 14. A dual-purpose buffet-lounge room, seating eight, is served from a compact kitchen.

The Bedrooms

Type-S bedrooms are used in all the cars in which there are bedrooms or compartments. These rooms have enclosed toilets placed between adjoining rooms, that for one room next to the corridor and that for the other next to the outside of the car. Between them, back to back are the lavatories in the middle of the end of the partitions of the bedrooms, with mirror-lined alcoves above. The lavatory and dressing mirrors are thus inside the bedroom rather than in the annex.

For daytime travel the lower bed folds up into the corridor partition and the upper raises into the ceiling. Two lounge chairs are folded and placed under the lower bed at night.

Decorative Treatment

The decorative treatment achieves desired results with a minimum of different paint colors and fabrics. In the 104 sleeping cars, for example, only eight paint colors and five seat covering fabrics are used, in conjunction with two colors of window-shade material and two carpet colors. Nevertheless, each type of sleeping-room accommodation has a distinctive decorative treatment. The effect is of more colors than were actually used as a result of the varied color combinations.

This method of using a minimum number of colors, fabrics and other materials reduces the stock requirements for maintenance and replacements. It also aids in more economical purchasing because of the fewer items in larger amounts than would otherwise be possible.

The tops of luggage shelves and shoe lockers are finished in gray linoleum. Window capping in sleeping rooms and open sections is brown molded plastic, which makes a comfortable arm rest because of the panel heating system. In the remainder of the car, the cappings are laminated plastic Pearlescent Formica.

Heater-pipe guards throughout are unpainted stainless steel, as are all Pyramid snap-on moldings in sleeping rooms. Door casings at entrance to sleeping accommodations are satin finish aluminum. All window-shade backing is aluminum color.

Construction of Car Bodies and Trucks

The cars are all 85 ft long, coupled, 9 ft 6 in. wide

inside and are Pullman-Standard girder-type construction, with corrosion-resistant, high-strength, low-alloy steel framework, and exterior sheathing. The exterior sides and roof are smooth and are painted to match the CNR standard color scheme. Decal-type lettering is used on all the car exteriors.

The cars are insulated with Owens-Corning Fiberglas As the car sides do not have extension skirts, no protective cover is applied over the vestibule steps, which are of the stationary type. A ribbed rubber-type floor covering is used throughout vestibules and on car steps.

All 141 cars are being equipped with Commonwealth four-wheel, outside-swing-hanger, all-coil-spring type trucks which include the large diameter center plate, friction-type vertical shock absorbers and 6-in. by 11-in. journals with Hyatt roller bearings. Fabreeka sound-deadening material is applied. Westinghouse HSC brake equipment is installed with A.S.F. unit-cylinder clasp brakes.

The cars are equipped with Type E couplers. The draft gears and buffing devices are Miner.

Eleven of the thirteen types of cars are equipped with Safety 25-kw axle-driven Genemotors with Spicer drives, providing 115-volt dc electric power for air conditioning, lighting and kitchen loads. The compartment-bedroom-buffet-lounge cars and the dinette cars have Waukesha diesel engine-driven generator units to produce 220-volt, 3-phase alternating current. These units, rated at 28.1 kw each, are self-contained and make it possible to park the cars for considerable periods, when necessary, without reliance on an external course of electric power. Both fluorescent and incandescent types of lighting are used, the illumination and style of fixtures being custom designed for the various types of rooms and passenger accommodations.

On nine of the thirteen car types the electric locker is adjacent to the car vestibule, an arrangement recommended by the American Railway Car Institute, Passenger Car Design Committee. As a safety measure, access to the 220-volt electric switchboards is restricted to qualified maintainers, with trainmen operating only start-stop switches and thermostat controls.

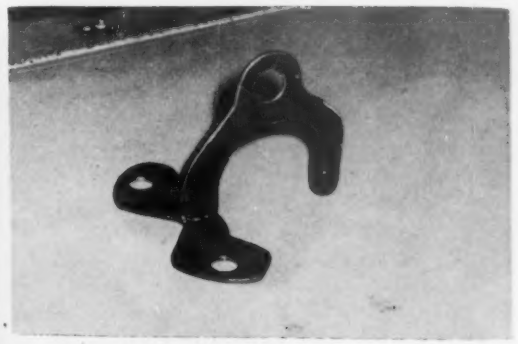
Air Cooling and Heating

Conditioned air is provided in each type of car, using Freon air-conditioning apparatus and controlled air exhaust. Eleven of the thirteen types of cars have Frigidaire air-cooling equipment rated at 7 and 8 tons' capacity, depending upon individual car requirements. The trane air-conditioning systems in the diners and dinette cars are rated at 8 tons' cooling capacity. Bedrooms, compartments, drawing rooms and open-section compartments have Multi-Vent air diffusers.

The Vapor heating equipment includes the Unizone type with two regulators in all open-body cars, such as the diners, parlor cars, and open diner and lounge sections. All sleeping rooms have Moduzone type controls with three regulators, one on each side of the car and one for overhead heat. There is one manually operated temperature control valve. Radiant panel type heating is used in all sleeping rooms of 104 cars.

For crew convenience, kitchens have their own separate air distribution systems by which cool air is directed into the areas requiring maximum heat dissipation. Ceiling exhaust fans are installed as required by the size of the kitchen and amount of heat developed.

To assure safe, palatable drinking water, the Everpure Superchlorination method is used. Taclor tablets are inserted while filling tanks and Everpure water purifiers remove chlorine from water used in water coolers and in dining cars for cooking and drinking only.

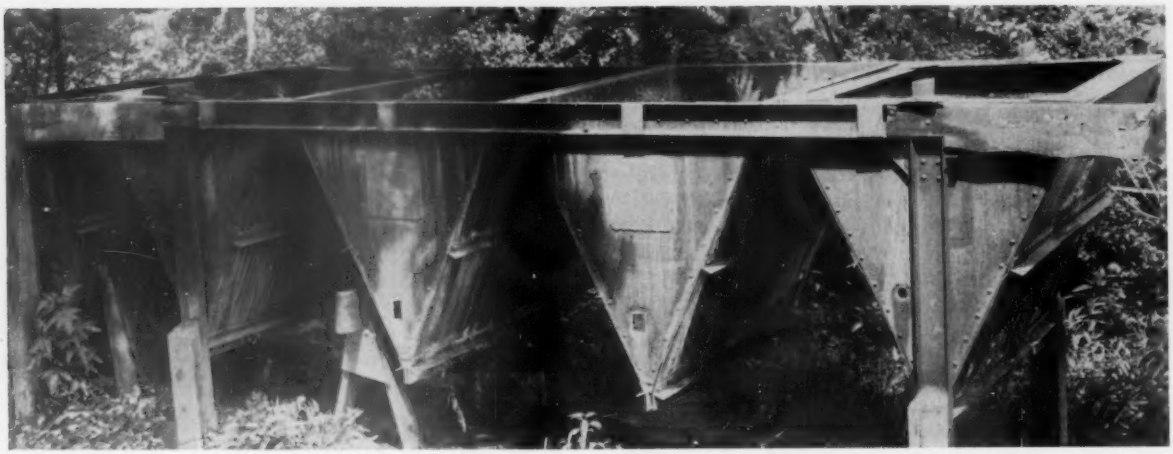


Center head lifter requires no bolts for securing and does not interfere with lowering head all the way in box. The close-up above shows the lifter, minus the pinned member that slips over the third stud and attaches to the small hole on the right.

Improved Head Lifter

The illustration shows three types of head lifters used at the shops of a mid-western road. A close-up of the one in the center is shown in the second view.

The advantages of this type head lifter are: (1) no bolts are needed to fasten it in place whereas the others require two; and (2) it permits lowering the head into the box as there is no interference beyond the edge of the head. This lifter is also capable of handling a completely assembled head. It is made of 3/16-in. steel.



Experimental coal hoppers under test in the yard of the Aluminum Research Laboratories, New Kensington, Pa. This illustration shows the condition of the all-aluminum hoppers after 25 years and composite hopper (right) after 17 years. The holes and patches in the vertical end sheets of each hopper resulted from the previous removal of samples for tensile tests and microscopic examination.

Aluminum Alloys in Hopper Cars

An appraisal of the results obtained in 75 experimental cars of 11 owners and in different classes of service indicates the adaptability of aluminum alloys for hopper-car construction.

The interior surfaces of one of the aluminum-alloy hoppers after 20 years' exposure, during which it was filled with Illinois coal. The patches were welded to the hopper as a covering for the openings created by samples removed previously for tensile test and microscopic examination.

By E. T. Englehart and G. B. Hauser

ALUMINUM alloys, by virtue of their useful combination properties—especially light weight, wide range of mechanical properties and good resistance to corrosion—are ideally suited for use in the transportation industries. While a large percentage of the aluminum used in this field is employed in aircraft applications, other branches of this industry have been rapidly increasing their use of this metal. The railroad industry has increased its utilization of aluminum alloys with the fabrication of many aluminum-alloy tank cars and the use of aluminum alloys for trim, as well as the side and roof construction of passenger cars.

Railroad hopper cars have long been considered one of the most promising applications. Today, aluminum alloys that combine adequate strength, good formability, good weldability, good resistance to corrosion by coal and excellent resistance to atmospheric weathering are available for hopper car construction. Although aluminum hopper cars have a higher initial cost than those of con-

Mr. Englehart and Mr. Hauser are both with the Aluminum Company of America, the former with the Chemical Metallurgy Division, Aluminum Research Laboratory, and the latter, chief railroad engineer, Sales Development Division.

TABLE 1—HOPPER AND GONDOLA CARS IN SERVICE EMPLOYING ALUMINUM ALLOYS

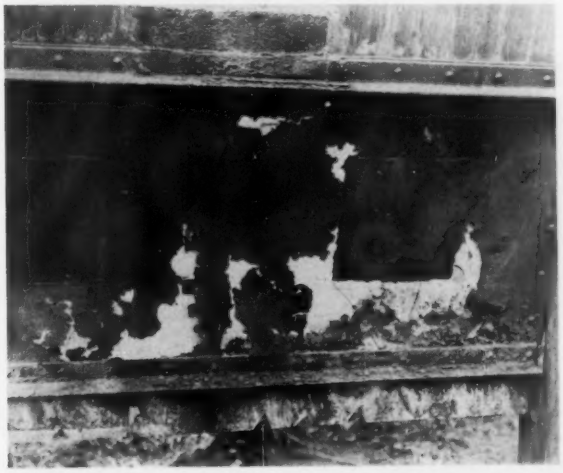
Owner	No. of cars	Capacity tons	Year built	Primarily alloy contacting lading	Lading	Amt. aluminum employed, lb Per car	Amt. aluminum employed, lb Total	Amt. steel replaced, lb Per car	Amt. steel replaced, lb Total
Aluminum Ore Co.	10	70	1932	4S-H32	Bauxite, Coal	12,596	125,960	21,700	217,000
Pennsylvania	1	50	1932	4S-17S	Coal	3,888	3,888	9,490	9,490
Baltimore & Ohio	1	55	1934	4S-F, 52S-H32	Coal	10,175	10,175	16,185	16,185
Chicago, Burlington & Quincy	1	55	1944	52S-F, 61S-T6	Coal	5,450	5,450	8,400	8,400
Missouri Pacific	25	70	1945	61S-T4, -T6	Coal-15 Sulfur-10	10,060	251,600	13,000	325,000
Montour	1	70	1946	61S-T4, -T6	Coal	10,060	10,060	13,000	13,000
Illinois Central	5	50	1947	61S-T6	Coal	6,000	30,000	9,800	49,000
Chesapeake & Ohio	5	50	1948	61S-T4, -T6, -T62	Coal	6,000	30,000	11,200	56,000
Southern	25	55	1948	61S-T6	Coal	1,915	47,875	3,482	87,050
Southern Pacific	1	70	1937	4S-H34	Sulfur	3,465	3,465	6,500	6,500*
Texas & New Orleans (Gondola car)									
Total	75						518,373		787,625

*Wood.

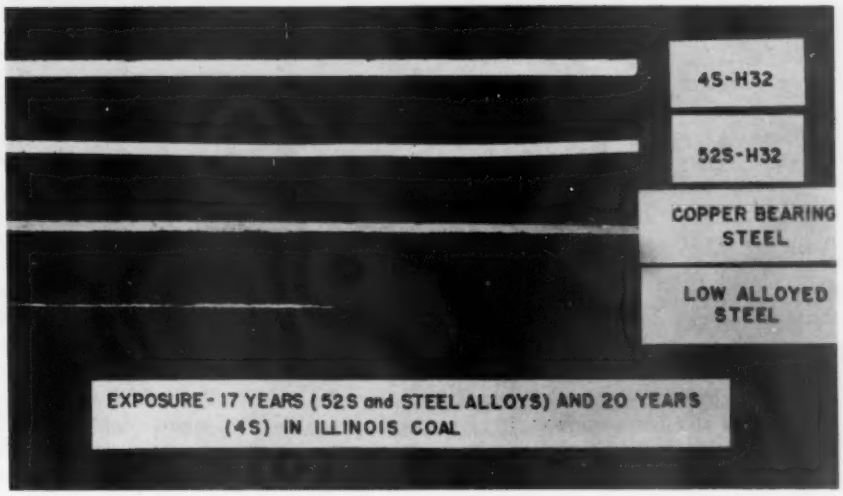
TABLE 2—NOMINAL COMPOSITION OF ALUMINUM AND STEEL ALLOYS EMPLOYED IN EXPERIMENTAL COAL HOPPERS

Alloy	Nominal composition, per cent: Copper	Silicon	Manganese	Magnesium	Chromium	Nickel
3S-H12	....	....	1.2	...	....	....
4S-H32	....	....	1.2	1.0	....	....
52S-H32	....	....	....	2.5	0.25	....
High-strength low-alloy steel (1)	0.39	0.87	0.28	...	0.95	0.04
Copper-bearing steel (1)	0.21	....	0.44	...	....	....

Notes:
(1)Actual composition of material employed.



The outside of the low-alloy steel sloping side sheet of the experimental composite hopper after exposure of 17 years while filled with Illinois coal. The patches on the low-alloy steel were installed to cover openings created by the removal of specimens for tensile tests and microscopic examination at the eight-year inspection period. Mild-steel angles were used in the construction of this hopper.



Cross-section of sections removed from experimental coal hoppers after 17 and 20 years. The 4S-H32 was originally 0.25 in. thick; the 52S-H32 and copper-bearing steel, 0.188 in. thick, and the low-alloy steel, 0.156 in. thick. Note that neither aluminum alloy has shown any overall thinning with the attack occurring at small localized sites.

ventional materials, they are less expensive in the final analysis. The benefits obtained from the increased initial cost can best be realized, of course, by the use of such cars in closed or "captive" service. However, the advantage of reduced maintenance resulting from the use of aluminum alloys can be obtained regardless of the type of service in which the car is employed.

In 1932, an eastern railroad built a hopper car of Alcoa aluminum and exposed it continuously to coal. After eight years of constant exposure the car was in such condition that it was estimated that it would have withstood such conditions satisfactorily for many more years. The car was then placed in active service.

In 1931, Aluminum Ore Company, an Alcoa subsidiary which has now become the Refining Division of the company, purchased 10 hopper cars fabricated entirely of aluminum. These cars were in coal and bauxite service until 1948, when they were placed in yard service at the Alcoa (Tenn.) Works, handling coal. Because of the high daily mileage traveled by these cars their 17 years of railroad operation has been estimated to be equivalent to 39 years of ordinary service. Today, after 22 years of use, the cars are still in operation and have shown excellent resistance to corrosion, requiring little maintenance from this cause.

An analysis made some years ago of the AAR standard 50-ton hopper car shows that, with an all-aluminum body and underframe, a weight saving of 12,270 lb over a similar car fabricated from steel is possible. To obtain the most economical advantage of this weight saving,

TABLE 3—NOMINAL COMPOSITION AND TYPICAL TENSILE PROPERTIES OF ALUMINUM ALLOYS THAT HAVE BEEN OR MAY BE EMPLOYED IN HOPPER CARS

Alloy	Nominal composition, per cent					Typical tensile properties		
	Copper	Silicon	Manganese	Magnesium	Chromium	Tensile strength, psi	Yield strength, psi	Elongation, per cent
3S-H12	....	...	1.2	...	....	19,000	17,000	10
4S-H32	....	...	1.2	1.0	....	31,000	22,000	10
52S-H32	....	...	...	2.5	0.25	34,000	27,000	12
61S-T6	0.25	0.6	...	1.0	0.25	45,000	40,000	12
62S-T6	0.25	0.6	...	1.0	....	45,000	40,000	17
A54S-H34	....	...	...	3.5	0.25	42,000	33,000	1
XC56S-H12	....	...	0.1	5.00	0.1	(1)	(1)	(1)

Notes:
(1)Data not established.

the car should be increased in length to provide more lading capacity. In this case, as much as 200 cu. ft. additional capacity, equivalent to about 6.13 tons of coal, is obtained. A midwestern railroad has constructed 25 hopper cars in which additional capacity has been obtained through this design feature.

Different amounts of aluminum can be used in hopper cars, varying from the amount employed in an all-aluminum car to that of cars with only aluminum end and side sheets. The latter method was employed by a southern railroad in repair of 25 hopper cars of 55 tons capacity. Each car used 1,900 lb of aluminum alloys, an amount that resulted in a weight saving of 3,500 lb per car. Since the dimensions of these cars remained the same, no increased capacity was obtained but decreased maintenance costs should be realized.

Laboratory Tests

Concurrent with the initiation of the preceding field tests, Alcoa Aluminum Research Laboratories started an investigation in 1932 to determine the suitability of aluminum alloys for hopper-car construction. Four small hoppers, each composed entirely of aluminum alloys and capable of holding approximately one ton of coal, were constructed and erected in the yard of the Alcoa Aluminum Research Laboratories at New Kensington, Pa. These hoppers were of riveted construction and employed vertical end sheets of Alcoa alloys 17S-T4 and Al7S-T4 and sloping side sheets of Alcoa alloys 3S-H12 and 4S-H32. Rivets and structural angles of 17S-T3 alloy were used in these hoppers.

Although alloys 17S and Al7S performed well under tests, they have been superseded by others having improved properties for use in hopper cars. Different types of coal were placed in each of three hoppers in an effort to determine the effects of intermediate sulfur content (Illinois coal), another of intermediate sulfur content (West Virginia coal) and a low sulfur-bearing coal (Pennsylvania coal) on the performance of the various aluminum alloys employed in the hoppers. One hopper remained empty for comparison purposes.

In 1935, another hopper composed of vertical end sections of copper-bearing steel and sloping side sheets of high strength-low alloy steel (Cu—0.39%, Si—0.87%, Mn—0.28%, Cr—0.95%, Ni—0.04%) and Alcoa 52S-H32 aluminum alloy was added to the test. Rivets and structural angles of mild steel were employed in this hopper. There was a three-fold purpose for the inclusion of this hopper in the test: (1) to determine the performance of Alcoa 52S alloy under these conditions, (2) to determine if aluminum alloys could be used satisfactorily in contact with steel in coal service and (3) to provide ferrous materials often used in this application as a basis for comparison for the aluminum alloy hoppers previously constructed, without which the test data would be difficult to interpret. The composite hopper was filled with Illinois Coal in order to be comparable with one of the hoppers composed entirely of aluminum alloys and previously installed.

The coal employed in each of these hoppers was removed and replaced with coal of the same type approximately every two years throughout the duration of the test. Each time the coal was changed the component parts of each hopper were given at least cursory examination. Complete detailed examination of all parts of each hopper was carried out on several occasions during the test. Since these hoppers have now been exposed for periods

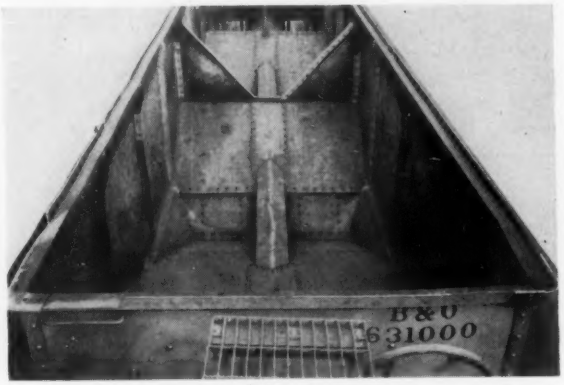
TABLE 4—AVERAGE ANALYSES OF VARIOUS TYPES OF COAL

Type	Moisture	Volatile matter	Fixed carbon	Ash	Total sulfur	Other soluble salts	pH	Btu
West Virginia.	1.21	37.77	50.26	10.76	2.96	0.14	5.3	13016
Pennsylvania.	0.74	32.80	51.28	15.14	2.16	0.21	6.3	12515
Illinois.....	2.69	39.49	48.14	9.68	3.73	1.06	4.2	12315

TABLE 5—RESULTS OF TENSILE TESTS CONDUCTED ON REPRESENTATIVE SAMPLES REMOVED FROM LOWER .. PORTIONS OF EXPERIMENTAL COAL HOPPERS

Alloy	Original thickness, in.	Exposure period, years	Loss in tensile strength by corrosion per cent[1]		
			Illinois coal	West Virginia coal	Pennsylvania coal
4S-H32	0.250	20	9	7	6
3S-H12	0.188	20	15	18	13
52S-H32	0.188	17	15	.. ..	..
Copper-bearing steel	0.188	17	40	..	..
Low-alloy steel	0.156	17	100[2]	..	..

Notes:
[1]The values listed are the average of five standard A.S.T.M. tension specimens.
[2]Large perforation occurring in sheet.



The interior surfaces of the B&O hopper arc after 14½ years' service. The interior surfaces were in excellent condition with little corrosion in evidence (measured depth of attack averaged only 0.010 in.). The rivets were steel and had not caused any special attack.

The longitudinal hood and cross-ridge area of one of ten of the Aluminum Ore Company's aluminum cars after 22 years' service hauling bauxite and coal. Note that the 4S alloy sheet (¼ in. thick) was in good condition except for some minor gouges and abrasions.

of 17 to 20 years (which exceeds appreciably the average life of a conventional hopper car without major repairs) the most extensive examination has been carried out at this time.

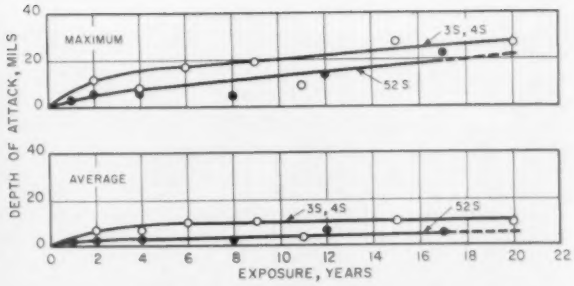
These examinations, made on the experimental coal hoppers, included a detailed visual inspection of all component parts and microscopic examination and tensile tests of typical samples removed from representative areas of each hopper.

All-Aluminum Hoppers—20 Years

After a period of 20 years, all hoppers composed entirely of aluminum alloys appeared to be in good condition. The hopper that had remained empty throughout the test revealed only mild weathering and an accumulation of atmospheric soil, which is typical of materials exposed for this period of time to the industrial atmosphere at New Kensington, Pa. The hoppers that contained the various types of coal revealed a mild to moderate general attack and discoloration from the coal. All hoppers were in about the same condition, which indicated that aluminum alloys 3S and 4S had resisted attack by all the various types of coal to about the same extent. It was apparent that the hopper sheets had suffered somewhat more attack in the lower areas where they had been subjected to leach from the coal, than in the upper areas which, of course, were subjected to substantially less leaching. In no case, however, had corrosion affected the structural integrity of the hoppers to any great extent.

Composite Hopper—17 Years

Similar examinations of the composite hopper after 17



Graphs showing the average and maximum depths of attack of aluminum alloy (3S, 4S, and 52S) parts of experimental coal hoppers containing Illinois coal. Note that while the attack of the 3S and 4S (open circles) was almost identical and slightly greater than that of the 52S (solid circles), the rate of attack of all alloys decreased markedly with time.

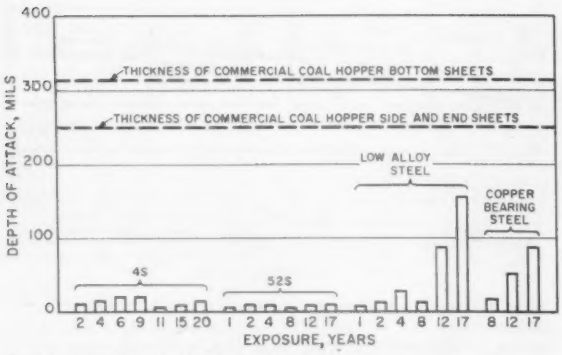
years' testing disclosed that the 52S aluminum alloy members (0.188 in. thick) were performing in much the same manner as the members of the hoppers composed entirely of aluminum alloys. However, the low-alloyed steel members (0.156 in. thick) had suffered severe thinning and large perforations during this period. The copper-bearing steel vertical end sections (0.188 in. thick) were somewhat less affected than the low-alloyed steel members, although they had thinned appreciably.

Microscopic examination and tensile tests were made on representative sections removed from both upper and lower areas of the sloping side sheets of each hopper. Since the lower areas represent the most corrosive condition in the hoppers, only the results of tests made of these sections are reported.

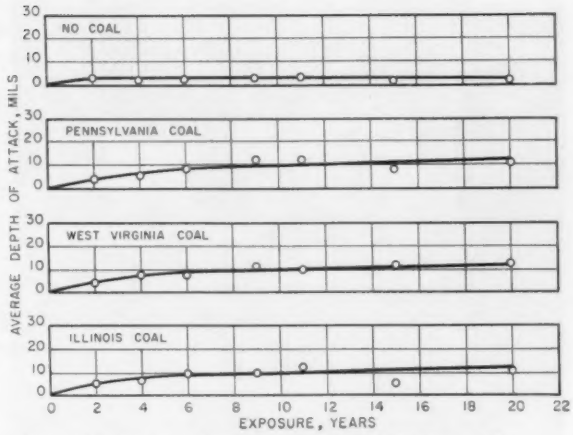
These two methods of evaluation were chosen since they have been found to be a more informative and practical means of determining the effect of corrosion on aluminum than weight loss measurements. Tensile tests are more sensitive criteria since they select the cross-section that has corroded to the greatest extent, while measurement of depth of attack by microscopic examination provides a more realistic measure of the rate of penetration.

All tensile tests were conducted using standard A.S.T.M. tension specimens.[1] The effect of corrosion on the strength of all materials was established by comparing the tensile strengths (based on the original cross-sectional areas) of the exposed specimens with those of uncorroded specimens. The depth of attack was determined metallographically. Several cross-sections, including the most conspicuous areas of attack, were polished and the depth of attack measured (X100) by the use of a microscope fitted with a Filar micrometer-eye piece. For each lot of material, the maximum depth of attack observed was measured. In addition, a number of sites of attack were measured in order to establish the average depth of penetration. In substantially all cases, the original surface was sufficiently intact to provide a reference for accurate measurement of depth of attack. This latter value is the mean of the individual sites of attack and does not integrate the large areas over which no attack, or insignificant attack, had occurred. The penetration, as estimated from these measurements, will always be greater, particularly in the case of aluminum alloys, than that calculated from weight losses.

[1] Standard Methods of Tension Testing of Metallic Materials (EB-52T), 1952 Book of A.S.T.M. Standards, Part III, p. 1208.



Graphs showing the depth of attack of aluminum and steel parts of the experimental coal hoppers in relation to the recommended thickness of material used for commercial coal hopper cars. The average attack from both sides of these parts was used since the original surfaces of both sides of the steel parts had corroded, while the attack of the aluminum members was confined primarily to the side in contact with coal.



Curves showing the resistance to corrosion of 4S alloy to different types of coal. Note that the 4S resisted a high-sulfur coal (Illinois coal) as well as it did a low-sulfur coal (Pennsylvania coal). Also note that the rate of attack of the 4S alloy was about the same in all types of coal and that the self-stopping action exhibited in atmospheric weathering was also evident on those materials in contact with coal.

For the most part, the results of microscopic examination and tensile tests substantiated those of the visual examination. It is apparent from Table 5 that all the aluminum alloys showed relatively low losses in tensile strength after exposure to coal for 17 to 20 years. While both the 3S and 52S lost more in tensile strength than did 4S, consideration of the fact that the 4S alloy originally was thicker than the other alloys makes it apparent that they had all performed in much the same manner.

Microscopic examination for depth of attack also demonstrated the good performance of the aluminum alloys in this application. The average depth of attack of the most corroded sample, 3S in contact with West Virginia coal, was only 0.0177 inch. The 3S and 4S alloys suffered about the same amount of attack, while the 52S alloy was subject to slightly less attack, as shown by the chart in Fig. 5. It is also interesting to note that the rate at which the surfaces of these alloys were attacked in contact with coal decreased markedly after an exposure of about two years. The average depth of attack of these alloys was about 0.007 in. after the first two years, but only 0.010 in. after 20 years. This decrease in rate of attack apparently is the result of the same self-stopping action that limits corrosion of aluminum alloys under conditions of atmospheric exposure.[2] As a result of this self-stopping action, the average attack of the aluminum alloys, even after 20 years, had progressed to a depth of only about 7 per cent of the thickness recommended for coal hopper car construction. The maximum depth of attack had, in some cases, penetrated to a point of about 30 per cent of the recommended thickness for hopper car construction. However, this depth of attack is not particularly important, since in the case of aluminum alloys, the maximum attack is confined to extremely small, isolated areas that would not have any great effect on the performance of a coal hopper. These measurements also indicated that the aluminum alloys resist different types of coal equally well.

In the case of the steel alloys employed in the composite hopper, tensile tests were not conducted on the low-alloy steel, since large perforations had occurred, resulting in a loss of 100 per cent in tensile strength. The copper-bearing steel lost 40 per cent in tensile strength during its 17-year exposure. Microscopic examination was made of samples of the remaining portions of each of the materials employed. This examination revealed that the average attack from both sides of the copper-bearing steel was about 30 per cent of the original thickness, while the maximum attack was approximately 45 per cent of this thickness. Because of the large perforations that had occurred, the average total attack of the low-alloy steel in the lower areas of the hopper was considered 100 per cent of the original thickness.

It is apparent, from the results of these examinations, that all the aluminum alloys employed in these experimental hoppers have performed well for periods as long as 20 years. Conditions during these tests were certainly more severe from the standpoint of corrosion than those encountered in service where coal remains in the hopper cars for a period of only a few weeks, at most, before changing. Abrasion and other abuse encountered in service were not evaluated in this test, of course, but field tests have shown that aluminum alloys have performed adequately in these respects. From the standpoint of corrosion, however, conclusive evidence shows that cars fabricated from aluminum alloys should last the amortized life without any major repairs. In this respect, they should be far superior to the steel alloys commonly employed.

It is also evident that the difference in sulfur content of coal has little effect on the resistance of aluminum alloys to corrosion, with high-sulfur coals having about the same effect as low-sulfur coals.

In the composite hopper, the aluminum alloys had not suffered any special attack where contacting the low-alloyed steel or the copper-bearing steel. Although aluminum galvanically protects steel in many neutral solutions such as sea water, in solutions of many sulfur compounds the potential difference between aluminum and steel is small and, in some instances, the polarity between the two metals may reverse. In such cases, aluminum becomes cathodic to the steel. Limited laboratory tests have tended

(Continued on Page 70)

[2] C. J. Walton, D. O. Sprowls and J. A. Nock, Jr., "Resistance of Aluminum Alloys to Weathering", Convention of National Association of Corrosion Engineers, 1953.

Test stands for preliminary testing of lubricating materials and devices. The center instrument panel mounts six watt hour meters at the bottom to measure power consumption and three two-point continuous recording instruments. Stands operate at equivalent train speed from 40 to 80 mph.

Research Adds Force to Attack on Hot-Box Problem

American Brake Shoe Co. builds bearing laboratory as part of its already extensive research center at Mahwah, N. J.

RECOGNIZING the hot box on rolling equipment as one of the major problems confronting the railroad industry, the American Brake Shoe Co. has added to its extensive research facilities at Mahwah, N. J., a new section for the specific purpose of applying to the hot box problem the principles of scientific research.

Over a period of several years this company has conducted research with respect to such products as brake shoes, car wheels, journal bearings and trackwork and has built up a research center which involves $2,500,000 in facilities. That 1953 additions which include the new $250,000 bearing laboratory were built at a cost of $900,000. The entire research center employs 170 people and, in 1954, will spend about $1,500,000 in research work. This research center, for example, was instrumental in developing the company's cast-steel car wheel for the production of which a new plant is now being built at Calera, Ala.

Bearing Laboratory Facilities

The bearing laboratory which was designed by Brake Shoe and constructed as an extension of the Sargent Research Laboratory, has two floors, and measures about 65 ft by 40 ft. Although the building contains offices, storage space, and other facilities, the heart of the laboratory is the test room, and two other rooms directly associated with the test room. One of these is the control room, where all the operating and indicating devices are located. The control-room operator looks directly into the test room through a thermopane window. The other room associated with the test room is the machinery room, directly below. Here is much of the equipment necessary for running the tests, and also the dead weights used to load up the journal bearings under test.

The Test Room

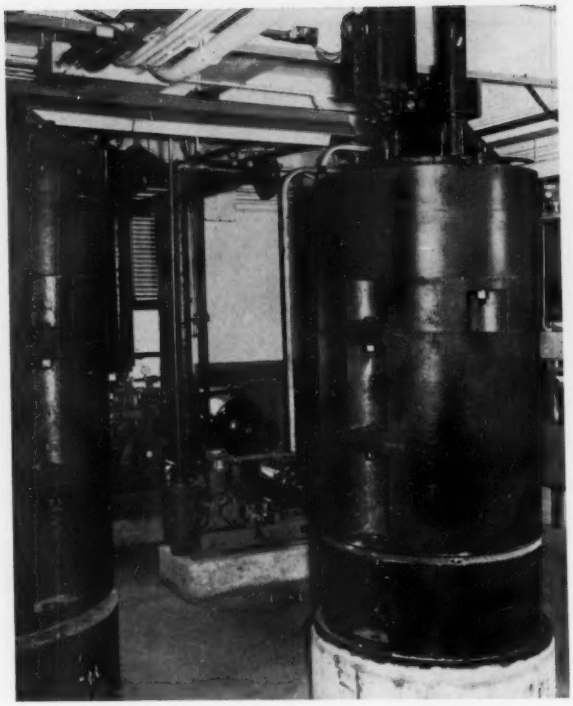
The test room can be held at any desired temperature from —40 deg. F to 125 deg. F, plus or minus 2 deg. A blower at one end of the room is used to obtain the correct temperature, whether high or low. Electrical heating units within the blower are energized for higher temperatures, and a refrigerant is circulated through the blower for low temperatures. Thermopane windows on two walls of the room allow observation during test, and a large insulated access door is provided for installation or removal of heavy machinery. A one-ton auxiliary overhead hoist in the test room is also provided for the handling of heavy parts.

Approximately in the center of the test room is the test machine, which consists basically of a power unit, a driven axle having standard journals and associated equipment on each end and provision for placing loads on the journal bearings. The power unit consists of two d c motors coupled with a magnetic clutch and rigged up to drive the test axle by means of a chain. The smaller motor is a 5-hp gear motor rated at 15 to 75 rpm. This motor is used for starting the test axle and for running it at equivalent train speeds up to 6 mph. Above this

speed the large 60-hp motor having a maximum rating of 1,750 rpm takes over (through the magnetic clutch) and drives the axle at equivalent train speeds to 115 mph. Tachometer generators are mounted on these motors to indicate speed and are calibrated to indicate in miles per hour for a 33-in. wheel, both on the control board outside and on the tape record of the test. The large drive motor is also equipped with a blower.

The test axle is mounted by means of two large main support bearings, of the solid bronze type. The backs of these bearings are slightly convex in profile, and their chucks, or seats, are concave to make them self-aligning. At either end of the test axle is a replaceable stub finished to AAR specifications for journals. Replaceable journals are used to permit running destructive tests. Over the two journals it is possible to install the standard AAR journal box, roller bearing assemblies, or other devices. At the present time standard journal boxes are being tested.

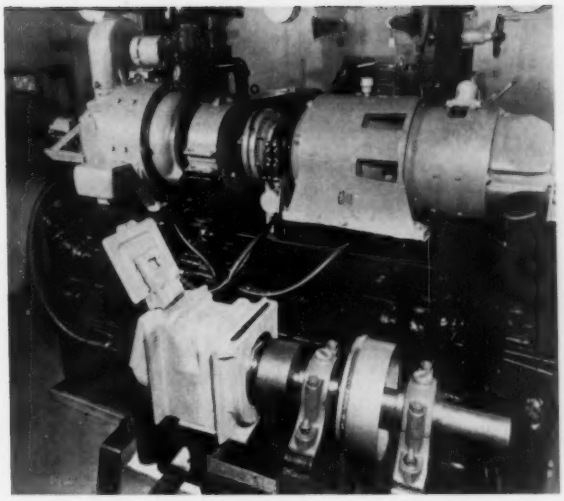
Load is placed on either journal box by means of a yoke. Two arms of the yoke straddle the box and extend down into the machinery room below, where weights can be hung on as desired. The yoke and weights comprise in effect a huge pendulum supported by and pivoted at the journal. The weights are of such size as to simulate an empty car, ¼ full, ½ full, ¾ full, and full. Top dead-weight loading is 20,000 lb per journal. Between the yoke and the top of the journal box is a Baldwin load cell, which provides indication of load on the tape record of the test. Also mounted near the top of the yoke is a motor driven jack for raising and lowering the pendulum to permit addition or removal of weights in the machinery room. A hand wheel beneath the motor may be used to do the same job manually. Across the top of the yoke is a calibrating arm which is used in connection with several removable weights for calibrating torque readings on the chart recorders.



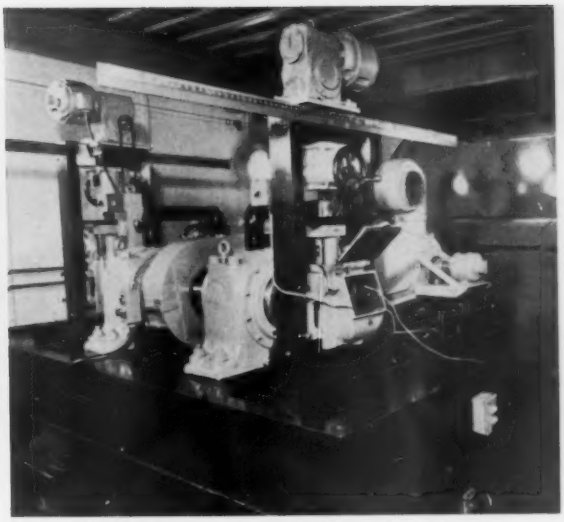
Dead-weight loading pendulums in the machinery room below the test room. Sections of these pendulums can be detached to give equivalent car loading for one quarter, one half, three quarters and full load. In the background are large and small compressors for refrigerating the test room.

The operator at the control panel logs information on a test. At the upper left are the oil-system indicators. Recording charts at left are for temperatures. The bank of amplifiers (left center) regulate sensitivity of instrumentation. At the operator's left elbow is the rape record of the test. In front of him are test machinery controls. At the right is another bank of amplifiers and the rest of the controls for refrigeration.

During a test, journal-bearing temperature and journal-box oil temperature, are indicated and recorded by means of thermocouples in the journal box. Displacement of the pendulum is a measure of torque, or friction, and is indicated by means of extremely sensitive pick-up devices mounted on the pendulums. When the test axle starts to



Rear view of the test stand showing driving motors and, in the foreground, one of the small, no-load test stands. The left-hand motor (60 hp) is coupled to the right-hand motor (5 hp) through a magnetic clutch. The small motor runs the test axle to 6 mph and the big motor takes it to 115 mph. The hood in the center covers the chain drive to the axle.



The test stand. The test axle carries a journal box on either end and rotates in solid main support bearings. The scale across the top is for calibrating the pendulum. The motor on top jacks the weight free of the journal for insertion or removal of the bearings.

rotate, for instance, an indication of starting torque is provided by an imperceptible swing of the pendulum. Once the test axle is running at a steady speed, the pendulum "settles down" at a slight angular displacement from vertical, and variations of one ten thousandth of an inch or less are then indicated and recorded by means of a second set of pick-ups, these even more sensitive than the first. They record running torque during the remainder of the test.

The arms of the yoke pass through an oil seal at the floor of the test room, which helps to maintain steady temperature in the room and prevents excess condensation around the pendulums during cold tests. Arrangements are also provided here to apply hydraulic loading to the journal, rather than the dead weight load represented by the weights on the pendulum. With the hydraulic system, it is possible to apply as much as 40,000 lb to the journal bearing.

The Machinery Room

The main components in the machinery room are two refrigeration compressors and an associated condenser, the two dead-weight loading pendulums, two motor-generator sets to supply dc power to the drive motors in the test room, and two oil systems, one hydraulic, and one for lubricating the mainsupport bearings on the test axle.

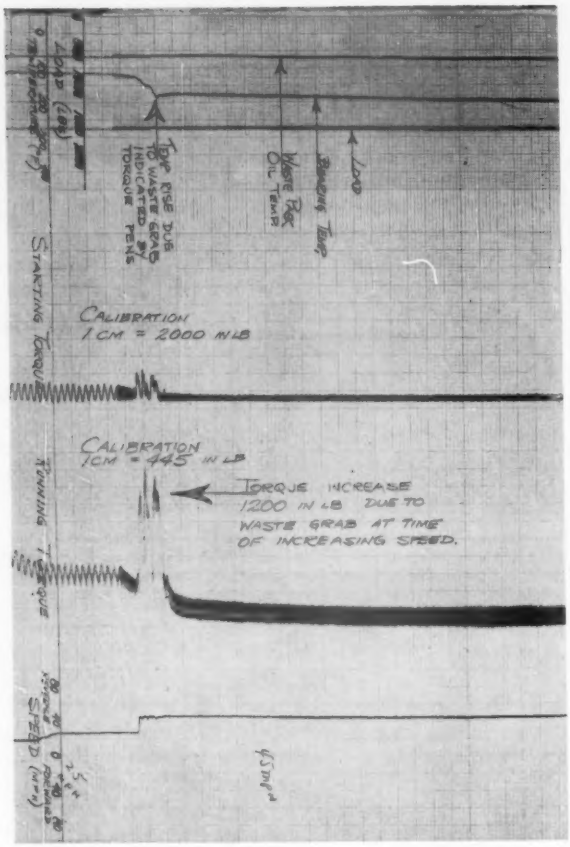
The large compressor, driven by a 40-hp motor is used for obtaining large temperature drops in the test room and for holding it at very low temperatures. The small compressor, driven by a 5-hp motor, is used for minor adjustments in temperature, and ffor holding at values slightly below outside room temperature. Any temperature setting made is automatically maintained in the test room through controls on the refrigeration system and the heating system. The controls, in turn, depend on information supplied by thermocouples located throughout the test room.

Because d-c power allows excellent speed control of motors, two motor-generator sets in the machinery room take ac power from incoming lines and supply dc to the two drive motors used to drive the test axle in the test room. The motor-generator sets are independent of each other, just as the drive motors are, and are controlled from the operator's panel in the control room.

There are also two independent oil systems in the machinery room, one supplying hydraulic pressure for auxiliary loading, and one supplying lubricating oil to the main support bearings on the test axle. Each system includes a storage tank, motor, pump, cooler, heater, and temperature control devices. The smaller system supplies bearing lubricating oil at about 30 psi and is powered by a 1-hp motor. The test axle cannot be rotated until oil has been pumped up through the main support bearings and back down to raise a float valve. If this system should fail while a test is in operation, the operator is warned by means of an indicating light. He may then shut down the test or he may let it run until the main support bearings reach a certain maximum temperature, at which time operation will stop automatically. The larger system, powered by a 15-hp motor, delivers hydraulic oil at approximately 1,000 psi, and also has a number of safeguarding features incorporated.

The Control Room

All of the equipment in the test room and the machinery room is controlled at the operator's panel in the control room. The focal point of the control room is the recording station, where a continuous record of test is made automatically. The tape indicates starting torque, running torque, load, speed, time, direction, test bearing temperature, and journal-box oil temperature for both of the journal bearings under test. The tape drive mechanism is adjustable for 16 speeds and can be speeded up at the operator's discretion for close observation during certain periods of the test. A log book, microphone, and tape recorder provide for any verbal or written comment



A typical section removed from one of the chart recorders. The pen at the bottom indicates train speed in miles per hour. The next pen indicates running torque; the third pen, starting torque, and the last pen, two temperatures and load, by means of an electronic switching unit. Interesting points have been indicated by large arrows. Chart speed can be set from 0.025 milimeters per second to 50 milimeters per second. Variations in chart speed can be noted best by the difference in color of the extreme left pen, the lighter at the bottom being at a speed of 0.5 milimeters per second; the remainder, at 0.05 milimeters per second.

that the operator wants to make while the test is in progress. The same microphone is hooked into a public address system so that the operator can communicate with workers in either the test room or the machinery room.

In another room of the laboratory is a row of no-load journal bearing test stands used for preliminary testing of lubricating materials and devices. Each of these stands consists of a journal box, bearing, wedge, and a stub axle with standard journal that is driven by an electric motor. Power to the motors is metered to provide a relative indication of the power consumption of lubricating mediums under test. Leading and trailing edges of the bearings on these stands are modified in such a way that excess oil at these points is drawn off in graduates for measurement and the operating temperatures of the bearings are chart recorded. Before any particular lubricating device is put into the main test room, it is run through the small stands for preliminary checking.

The laboratory is also equipped with facilities for making standard tests on lubricants and materials and has a specially designed machine for testing the bond strength of journal bearing lining.

Aluminum in Hopper Cars

(Continued from Page 66)

to confirm this relationship between aluminum and steel in contact with wet coal.

Service Experience

The performance of the aluminum alloys in the experimental hoppers as indicated by the results of these detailed tests has been substantiated by similar examinations of samples removed from coal hopper cars in service. In 1948, the opportunity was presented to examine an aluminum hopper car after 14½ years' service. It was found that the car was in good condition with only a mild attack being present on the surfaces contacting the lading. There was somewhat more attack on the lower portions of the hopper car sheets. Microscopic examination of cross-section of representative samples removed from the lower portions of the hopper slope sheets substantiated visual examination by indicating that the attack of this ¼-in. thick 52S-H32 material was of a minor nature. The average depth of attack of the surface in contact with coal was only about 0.010 inch. Tensile tests also confirmed that the material was performing satisfactorily.

Further substantiation of the performance of aluminum alloys in hopper cars was found during recent examination of Aluminum Ore Company cars after service of 22 years hauling coal and bauxite. Visual examination revealed that the interior sheets were still in good condition with only mild corrosion in evidence. Microscopic examination indicated that the average depth of attack of this 4S sheet was only 0.006 in. after this period of service.

Choice of Aluminum Alloy

Since the construction of hopper cars is not controlled by the specifications regarding tensile strength-yield strength ratios that are observed in passenger-car construction, a wider variety of aluminum alloys is available for use in hopper cars. As a result, the heat treatable alloys 61S and 62S and the strain hardenable alloys 4S, 52S, A54S, and XC56S can be employed in hopper cars. Alloys A54S and XC56S are particularly adapted to welding applications since they can be welded in certain tempers (O, F, and H112) without any appreciable decrease in strength in the weld area. The 61S and 62S alloys are especially suited to rivet applications, although they are sometimes employed in welded construction, while 4S and 52S alloys can be used in either welded or riveted construction. The latter alloys, however, are most commonly employed in riveted construction.

While alloys 61S, 62S, A54S, and XC56S were not included in these particular tests, service experience with coal and other types of material has indicated that these alloys should have a resistance to corrosion as good as, if not better than, the alloys included in these tests.

In conclusion, 20 years' experience with experimental hoppers, fortified by a similar length of service with limited field installations, indicates strongly that aluminum alloy hopper cars can be used with great advantage by the railroad industry.

Control Devices Eliminate Flashovers Caused by Wheelslip

Tests made on the Lehigh Valley also show that with good maintenance motors and generators are relatively immune to flashovers

By J. R. Schoonover and
H. R. Stiger

J. R. Schoonover

H. R. Stiger

MUCH has been said pro and con regarding the relationship of wheel slip to flashovers on diesel-electric locomotives. Design theory shows a definite correlation between armature speed and flashovers in a traction motor. The experience of one railroad operating diesel-electric locomotives for approximately six years indicates that effective wheel slip protection will materially reduce the number of flashovers on both traction motors and generators.

In the spring of 1948, the Lehigh Valley substituted diesel-electric locomotives for steam power in passenger service. Shortly thereafter, considerable trouble was experienced in the maintenance of traction motors and generators. Certain characteristics of these difficulties indicated that they were the results of wheel slippage.

Parts of the railroad's main line between New York and Buffalo are quite mountainous. In one territory the grade reaches a maximum of 1.8 per cent. Investigation showed that an excessive amount of wheel slip and flashing on both traction motors and generators was occurring in heavy passenger service over these mountain grades. This was particularly true in bad weather, when there was frost on the rail, or when falling leaves accumulated on the track.

A number of difficulties were encountered that could be traced to overspeeding of the motors during wheel slip:

1. Armature bands were shifting and also breaking. This necessitated removing the motors between normal overhaul periods and reduced the mileage per motor outage to a low figure.

2. Shifting of the bands allowed the coils to flare out and lock the armature. In addition to further damaging the motor, this locked the axle and driving wheels.

3. Severe cases of traction motor flashover often required removal of the motor for cleaning before it could be put back into service. Frequently armature

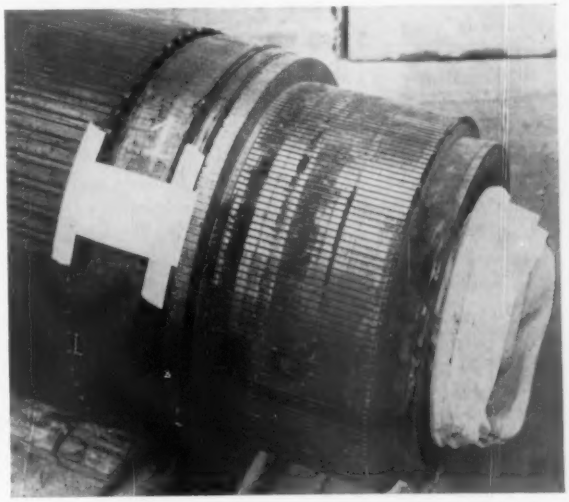


Fig. 1—Traction motor armature damaged by flashover.

Mr. Schoonover is assistant electrical supervisor, Lehigh Valley, and Mr. Stiger is in the Locomotive and Car Equipment Department of General Electric Company.

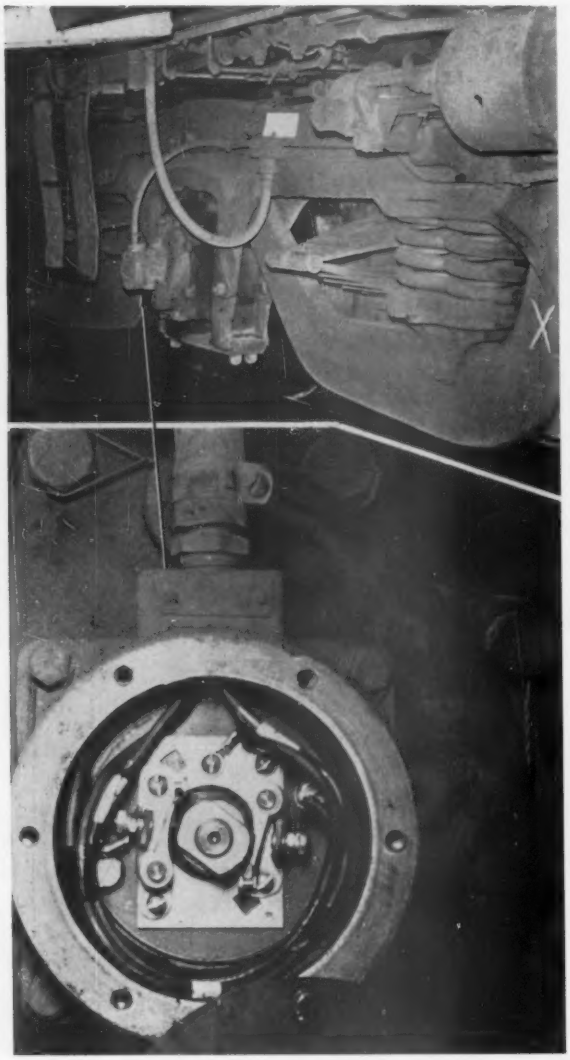


Fig. 2—Type of axle switch used, and installation on truck of Lehigh Valley locomotive No. 601.

coil leads were found to be loose in the commutator risers.

4. Flashovers on the traction motors usually resulted in a flashover on the main generator. The cumulative effects of these flashovers necessitated extra maintenance on the generators, such as cleaning of the brush holders and commutator string bands, renewal of brushes and resurfacing of commutators. In the most severe cases it was necessary to remove the generator from the engine for clean-up.

In seeking a solution for these difficulties consideration was given to changing gear ratio on the locomotives. Inasmuch as they were geared for a maximum speed of 80 m.p.h., it was thought that a lower gear ratio, giving higher maximum speed, might alleviate the trouble. However, after further investigation and consultation with the builder's engineers, it was decided to apply the General Electric Company's wheel slip-slide detecting and protective system then in the final stages of development.

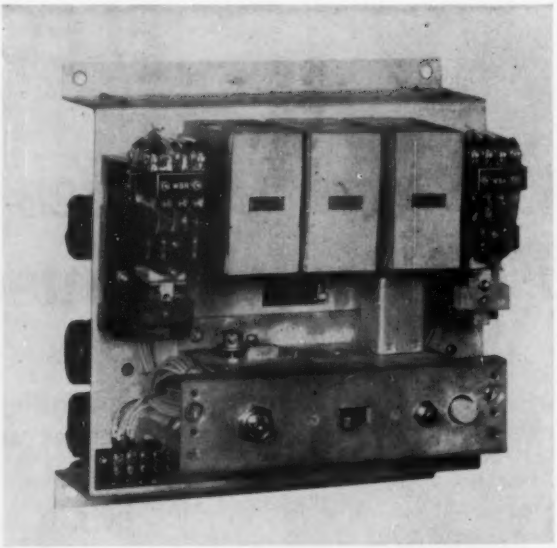


Fig. 3—Wheel Slip-side detection panel of the type installed on Lehigh Valley locomotive No. 601.

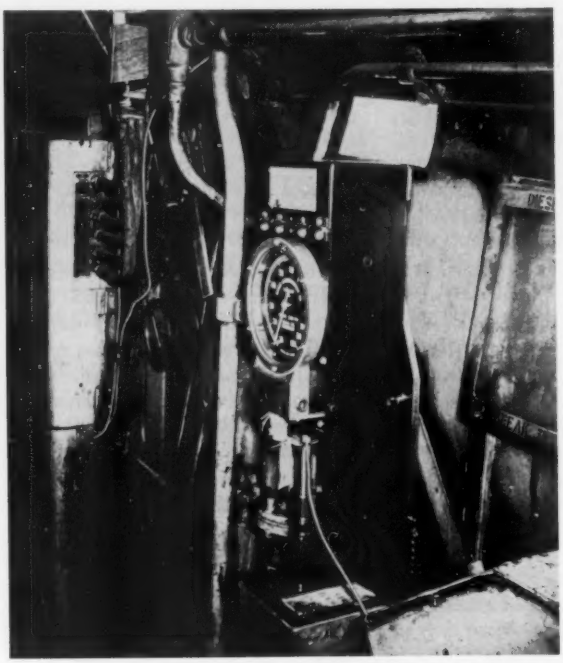


Fig. 4—Barco Manufacturing Company 10-120 m.p.h. speed recorder on Lehigh Valley locomotive No. 601.

A trial installation was made on several passenger locomotives. Later it was extended to the entire fleet.

At the close of 1951, a series of tests was conducted jointly by the Lehigh Valley and the General Electric Company on a 2,000-hp. road passenger locomotive. Observations were made continuously from December 16, 1951 to January 17, 1952 in regular scheduled service between Buffalo and New York. The locomotive was equipped with the General Electric wheel slip-slide protection system consisting of direct axle-speed sensing units (Fig. 2) on each axle, and a speed-comparison

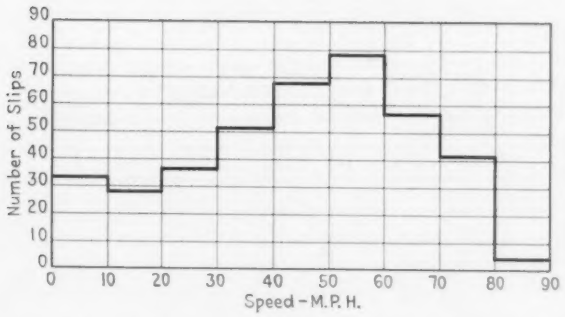


Fig. 5—Wheel slips occurred over the entire speed range in varying proportions.

panel (Fig. 3). When the difference in speed between the slowest and fastest axles reaches a predetermined value, the panel acts to momentarily reduce traction generator excitation, and to sound a buzzer and light a light at the engineman's position. If the speed differential is not corrected, after a suitable time delay, the panel acts to remove traction generator excitation, return the diesel engine to idle speed, and sound an alarm bell. The engineman is instructed to check for sliding wheels before resetting the panel.

In addition to the wheel slip-slide equipment, the locomotive under test was fitted with direct-drive 10-120-m.p.h. speed recorders (Fig. 4) lent by the Barco Manufacturing Company. One was connected to each motored axle and a continous recording was taken for 24,000 miles. These recordings showed axle speeds for all locomotive operations during the test period.

The recorder connected to motor number 2 axle had, in addition, two electrically operated pencils which recorded (1) when power was on the speed comparison panel, and (2) when the panel operated to correct wheel slip.

Theory of Wheel Slip and Flashovers

Tests showed that wheel slips occurred over the entire speed range, they occurred also in different motor connections and field strengths. Thus, general theory is dealt with in this paper regarding wheel slips and flashovers with no detailed attempt to deal with any specific motor connections and field strengths.

To examine the theory of overspeed flashovers, it is necessary to consider the voltage induced in an armature coil as it passes under a pair of poles pieces. The upper part of Fig. 6 shows a complete armature coil and the commutator segments to which it is connected. As can be seen, each side of the coil has a voltage (Ecs) induced in it as it moves under a pole piece. These two voltages add directly to produce the voltage between commutator segments. This voltage varies with the position of the coil and speed of the armature, as shown graphically in the bottom part of Fig. 6. The various voltage curves are here identified by locomotive speeds. This is possible since the armature speed is directly proportional to the locomotive speed. These curves show that the voltage between segments reaches a maximum each time the coil passes under a pair of poles. This value is called peak volts per bar. A glance at the voltage curves for various speeds shows that the peak volts per bar increases with speed.

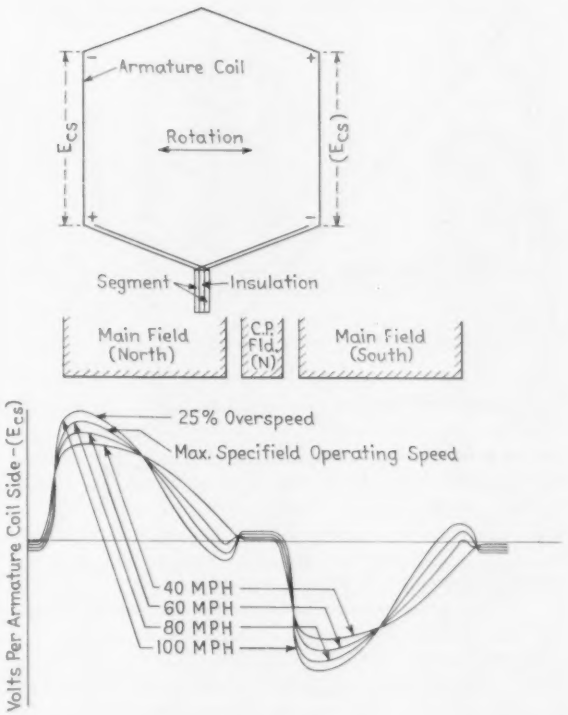
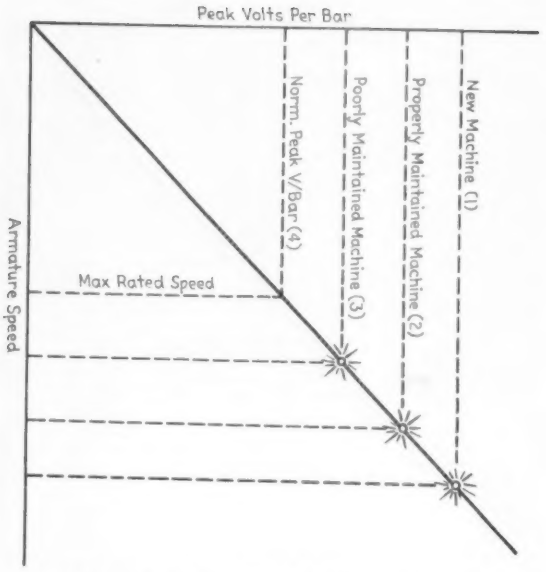


Fig. 6—Relation of volts between bars for varying locomotive speeds.

Now suppose wheel slip occurs. The speed of the motor on the slipping axle will increase, and its peak volts per bar will rise. If the speed of the slipping motor goes above its normal maximum speed, the peak volts per bar will exceed the normal maximum value. Naturally, the higher the speed goes, the greater the peak volts per bar will become. Under some conditions a value may be reached that will cause arcing to occur between commutator bars. This arcing will ionize the air at the commutator surface, making a conducting path between all segments. As a result, the segment arcing will increase until the conducting path reaches between brush holders and the motor flashes over.

The condition of the commutator will, to a great extent, determine the peak volts per bar at which the machine will flash over. When a machine is new, the insulation between commutator segments is at its best and the voltage required to cause arcing between segments will be a maximum. In service, a machine with clean commutator will naturally require a greater voltage between segments to cause arcing than one with a dirty commutator. If conducting material, such as oily carbon dust or copper grindings resulting from reconditioning is allowed to accumulate between the commutator segments, the voltage required to start arcing will be lowered. So, as the commutator condition becomes poorer, the machine will flash over at less peak volts per bar. This is illustrated by Fig. 7, which shows the relation between armature speed and peak volts per bar. No scale has been shown, since the location of the various points is relative only. The chart simply serves to indicate that proper maintenance of traction motor commutators will reduce flashovers.

As can be seen from Fig. 7, a commutator in poor



(1) Peak volts per bar condition at which a new machine would be expected to flash over.
(2) Peak volts per bar condition at which a machine which had proper commutator maintenance would be expected to flash over.
(3) Peak volts per bar condition at which a machine which had had poor commutator maintenance would be expected to flash over. (This limit depends on commutator condition. With very poor maintenance, it might even go below the normal peak volts per bar condition.)
(4) Peak volts per bar condition at which a machine would normally operate in service with no abnormal conditions.

Fig. 7—Whether or not a certain voltage between commutator bars is dangerous depends on the condition of the commutator.

condition (3) will stand only a slight increase in peak volts per bar before it flashes over. If the commutator condition is bad enough, the critical peak volts and corresponding speed may be so far reduced as to fall in the normal operating range of the motor. A properly maintained commutator, on the other hand, will have a higher critical voltage. This means that it will stand an appreciable increase in speed above normal before it flashes over due to peak volts per bar. A new motor allows considerable overspeed before the point of flashover due to peak volts per bar is reached. However, motor should not be overspeeded for other reasons such as mechanical limitations. Also, motor overspeed may produce excessive stresses in the commutator causing it to become rough. The roughened commutator may then cause the brushes to jump which may also result in flashover.

Once a traction motor flashes over, it almost invariably causes the main traction generator to flash over also. The reason for this is that the traction motor flashover acts as a partial short circuit on the generator. The resultant current surge produces excessive sparking on the generator commutator. This ionizes the air along the

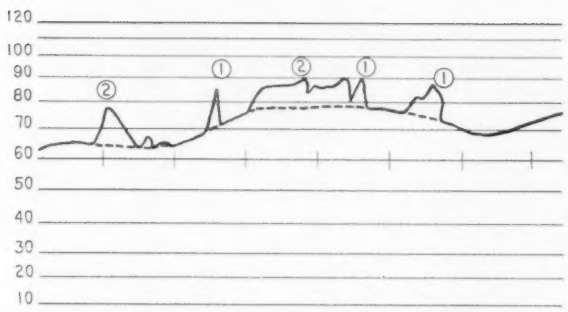


Fig. 8—Example of wheel slipping in regular operation. In about 14 per cent of the cases of wheel slip, all wheels slipped simultaneously.

commutator surface and forms a conducting path between brush holders. The generator then flashes over just as described for the traction motor.

From this theory, it appears evident that a reduction in the per cent of overspeed on traction motors will reduce the number of flashovers on both the motors themselves and the main traction generator. Hence, if it were possible to devise a wheel-slip scheme which would stop slips before they start, flashovers from this cause would be eliminated. Since, at present, it is not known how to do this, resort must be had to a system that will keep the overspeed of the motor to a minimum, thus avoiding the majority of overspeed flashovers.

With the original wheelslip system used on the Lehigh Valley passenger locomotives, overspeeds up to 35 per cent above the maximum permissible motor speed were recorded. At that time, great trouble was being experienced with flashovers and other damage resulting from overspeed, as already outlined. To overcome this trouble, the General Electric Company applied its new wheel slip-slide system. Tests in service on the same locomotives showed appreciably faster response. Maximum overspeeds recorded were approximately 17 per cent above maximum permissible speed.

Analysis of Test Data

These tests showed that wheel slips occurred over the entire speed range of the locomotive. This is graphically illustrated by the plot of the data in Fig. 5. It, therefore, seems evident that wheel slip was not directly related to motor connection or field strength. It is difficult to say how many wheel slips resulted in flashovers on the traction motors. Neither can it be said in what motor connections and field strengths they occurred, because no accurate record was kept of this. As will be pointed out later, however, the use of an improved wheel-slip detection system greatly reduced the number of flashovers. This agrees with the general theory regarding wheel slip and flashover.

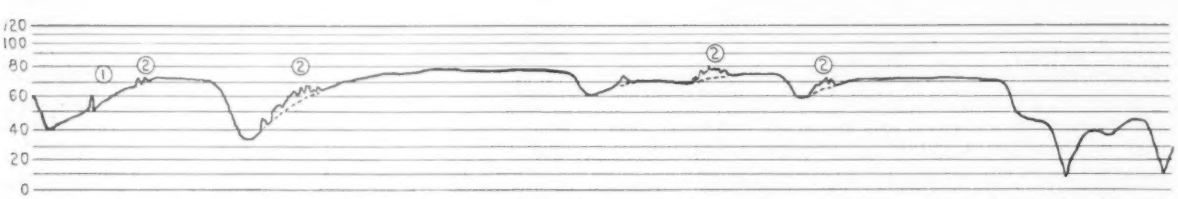


Fig. 9—Examples of wheel slips that were detected and corrected. Also shown are undetected, self-correcting slips which are better left undetected.

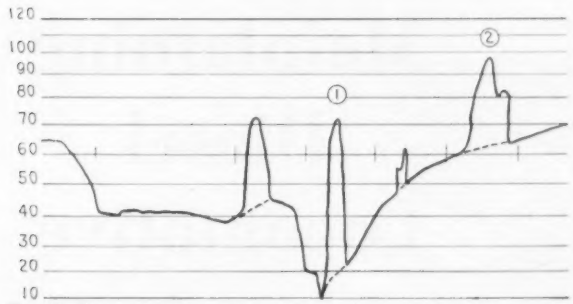


Fig. 10—Slips which occur at low (1), medium and high (2), speeds when the protection system is not working.

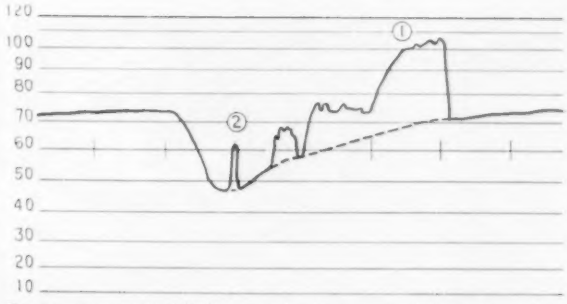


Fig. 11—Uncontrolled high speed slips in one of which 1, the motor speed exceeded its normal maximum by 35 per cent.

For the purpose of discussion, selection has been made of four sections from the traces made by the Barco speed recorders during the tests. To facilitate comparison the simultaneous recordings of the four instruments have been placed together on a single chart.

Figure 8 illustrates the performance of one motor in a case when all four motored axles were sliping simultaneously. Significantly, this is not an unusual condition. During the test period, it occurred in about 14 per cent of the cases of wheel slip recorded. It is evident, therefore, that a successful slip protection system should compare speeds of all axels including idle axles in order to sense multiple axle slips accurately. Since any axle can lock, it is also imperative to compare speeds of all axles for sure protection against wheel sliding. This is the type of system now installed on all Lehigh Valley passenger locomotives.

Figure 9 illustrates the case of a medium speed slip that was detected and corrected. It also shows the existence of undetected self-correcting slips. Such low-differential, self-correcting slips are best left undetected. They do no harm, and operation of the system to correct them would only reduce the net horsepower available for traction.

Figure 10 illustrates slips which occur at low, medium and high speed when the protection system is not operating.

Figure 11 illustrates uncontrolled high-speed slips. In this case the motor was overspeeded 35 per cent above its normal maximum of 80 m.p.h.

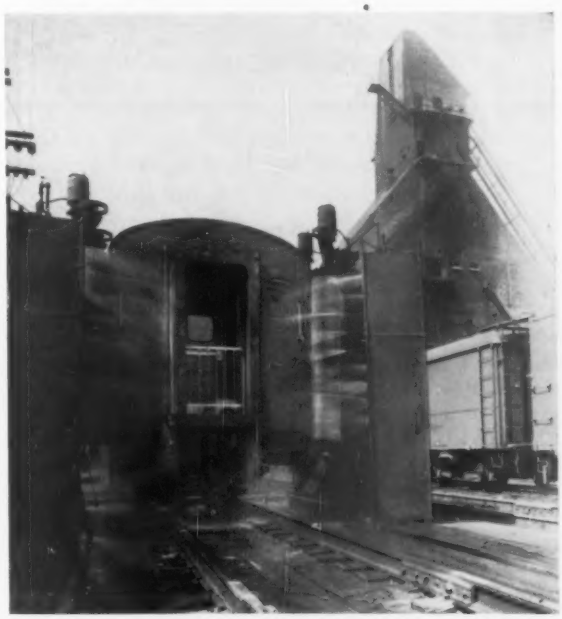
Results in Service

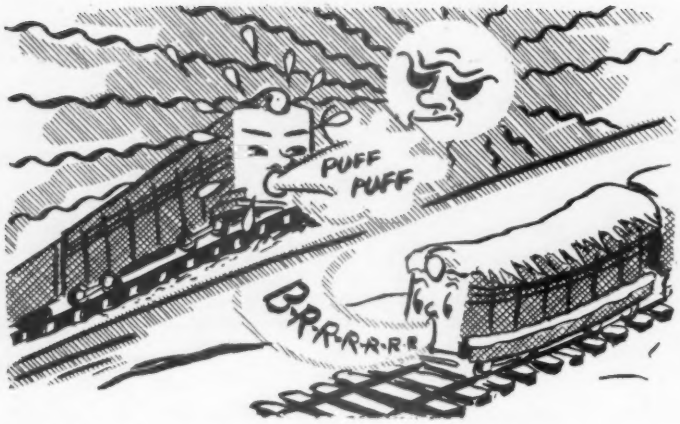
The experience of the Lehigh Valley indicates that since the application of the new wheel slip-slide protective system to passenger locomotives, the number of traction motor removals for rework as a result of flashovers has been reduced 75 per cent. It is felt that this reduction would have been even greater had not a number of motors been weakened through excessive slippage before the installation of the protective equipment. These ultimately failed and required repair.

On these same locomotives, flashovers on main generators have been reduced by approximately 80 per cent. As a result there has been a corresponding reduction in main generator maintenance.

After two years' experience with this application in service, W. E. Lehr, superintendent of motive power, Lehigh Valley, made the following statement. "We have succeeded in eliminating flashovers on traction motors and generators resulting from wheel slippage. One important element in achieving this end was the familiarizing of the enginemen with the characteristics of the equipment. They are now aware that it is necessary to take proper preventive measures, not only in the case of a locked wheel, but also to control wheel slip, since the device will automatically protect the locomotive in case of wheel slipping, and unload the unit affected. Therefore, they are alert to take immediate action to overcome the slipping and forestall automatic unloading.

"In operating between New York and Buffalo, we now have very little trouble as a result of wheel slippage, and we no longer have the needless repair expense formerly caused by high-speed slips. We might lose two or three minutes because of reductions in speed and the necessity of starting the unit again after the application of sand, but the wheel slip-slide device has more than paid for itself by eliminating the needless heavy maintenance previously encountered."

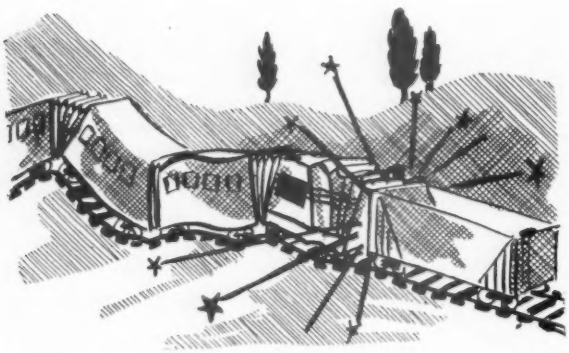

MOTORS REPLACE ELBOW GREASE. Seven days a week for 16 hours a day, 12 General Electric fan-cooled induction motors supply the muscle for this Pennsylvania car washer to clean an average of 200 cars a day. These motors have been in service every day since 1948 with practically no time out.



Heating and cooling causes expansion and contraction of conductors.

Maintaining Diesel Locomotive Electrical Equipment

The whole story in two small packages of what it takes to keep diesel-electric locomotives in good condition



Vibration and shock take their toll, particularly from traction motors.

By W. H. Eunson and T. L. Weybrew

Part I

A GREAT deal of emphasis has been placed on the high availability records made by diesel locomotives. This fact and the rapid acquisition of this type of locomotive has fostered a feeling that here is a new machine which needs only fuel to make it run a long time before it fails. In a good many cases, diesel locomotives do just that. But the failure, when it occurs, is so serious and expensive that preventive action is well justified.

Diesel locomotives were adopted by the railroads so widely, and so rapidly, that serious shortages in facilities, personnel and knowledge developed. In the early years, prior to 1910, diesel locomotives were maintained and repaired in buildings and with tools intended for use on steam locomotives. The men who did the diesel work were trained basically to care for steam locomotives, supervised in some cases by newer people who had been trained to some extent to care for diesel locomotives. Manufacturers, while urging more and better maintenance, had experience only on other applications of diesel engines and electrical apparatus to guide them. These conditions could not be improved very rapidly during the war years in spite of the great increase in the number of diesel locomotives put in service during this period.

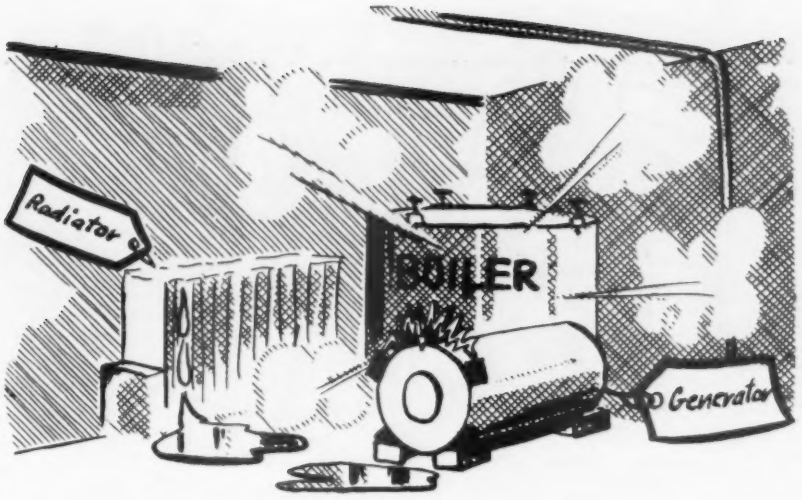
With the easing of restrictions after the war, diesel shops were built by many railroads, and facilities have been expanded greatly. Assistance in personnel training has been offered by manufacturers, and the larger railroads have established training programs. Such training must be a continuous process to keep up with the turnover of shop forces and the changes made in newer types of locomotives. Experience in the use of this type of motive power has resulted in the establishment of schedules for the inspection and maintenance of the various parts of the locomotive. These schedules will be revised as further experience is gained, but time or mileage between inspections must not be lengthened to the point where the cost of failures exceeds the cost of the inspection and maintenance postponed. Continuous efforts should be made to improve the thoroughness of the inspection and maintenance procedures to avoid service failures and their resulting delay and cost.

Operation

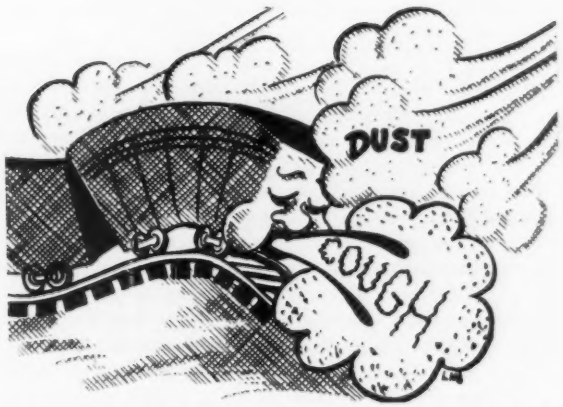
Conditions of operation vary greatly between the various railroads and at various points on the same railroads. From the maintenance point of view, they can be divided into two types.

The first, more common on smaller railroads, exists where the unit is cared for at one shop only. Such a unit may operate over an area far from its base point but returns there for periodic inspection and maintenance.

Both authors are in the Transportation and Generator Engineering Department of Westinghouse Electric Corporation, East Pittsburgh, Pa.



Water from rain, condensation and radiator and heating boiler leakage all work to break down insulation.



Both road dirt and carbon from brushes will make leakage paths across insulation.

Some operations of this type permit daily light inspections and best care can be taken under such conditions. Others permit inspection every few days or weekly and also encourage regularity, allows records to be kept, and fix responsibility for any failures experienced in service on such units.

The second type of operation makes the maintenance work more difficult. This type exists only on the larger systems. Units are operated in pools over large areas, usually with long runs and inspected at numerous points by various people, frequently without knowledge of the work done at previous inspections. Regularity and order are difficult under these conditions and conscientious and thorough work almost impossible. Failures are more frequent, and costs are high for the results obtained. The solution for such operating schedules is to assign the unit to a centrally located base shop and return it to that point as frequently as possible for most of the work to be done on it. Only light or running inspections are expected at other points on the system. Complete records must be kept to permit time or mileage overhauls at the periods established. Care should be taken to report premature failures and operating difficulties in enough detail to permit analysis of their real causes so that corrective action can be taken.

Cleaning the Machines

Maintenance of motors and generators consists, to a large extent, of preserving their insulating structure. The function of the insulating structure is, of course, to separate the windings of the machines from ground and to separate the various circuits into their different potential groups.

The principal factors which break down this insulating structure in locomotive service are:

a. The heating and cooling cycles of the equipment with attendant expansion and contraction of the conductors.

b. Vibration and shock. These are more severe on the traction motors than on the generators and auxiliary units.

c. Road dirt and carbon from the brushes themselves.

d. Water from rain, condensation, radiator and heating boiler leakage.

e. Oil from leakage and from the condensation of oil vapors.

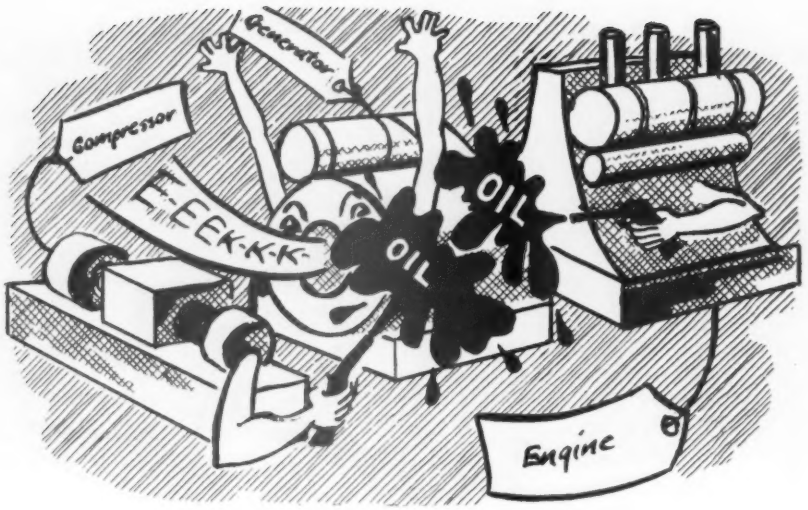
f. Cleaning compounds blown or drawn into the windings during locomotive cleaning procedures.

The insulating structure is composed of mica, asbestos and glass fibres used singly or in combination, bonded and filled with varnishes or compounds of high dielectric strength and high thermal stability. Similar insulating structures when used in industrial electrical machines, free from all but the first of these factors, frequently lasts for the entire life of the machine without further maintenance except for the periodic blowing out of dust.

This is not the case with diesel electric locomotive apparatus. The frequency and extent of heating and cooling causes a more rapid aging of the insulating structure, shrinkage becomes apparent and cracks form. With the shrinkage, vibration and shock loosen the coils and cause additional movement so that further deterioration from chafing occurs.

The road dirt, carbon dust, water and oil cover all creepage surfaces with coatings which are more or less conducting and the water and oil enters the cracks and creeps through the interior faces of the layers of insulation, thus hastening its destruction.

Maintenance under such conditions consists of a con-



Generators must breathe oily vapor and the resulting deposit must not be allowed to accumulate too long.

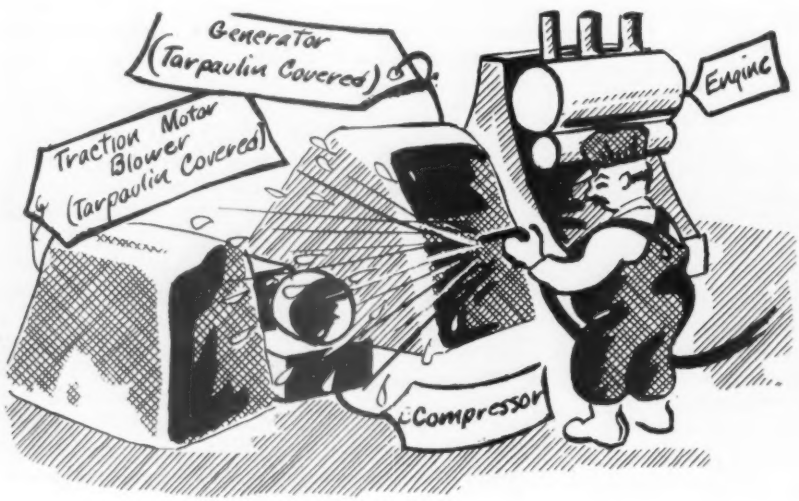
tinued effort to keep the equipment clean. Road dirt and carbon dust can be blown out if the blowing is done frequently enough but the question of water and oil is one of prevention. If these cannot be kept out of the machines, then the machines will have to be torn down frequently and thoroughly cleaned, if this is still possible, then dipped in varnish and baked. If oil is permitted to soak into the insulating structure, the machines may have to be rewound in a relatively short interval of time.

The exposure to oil is so general in diesel electric equipment that a number of maintenance centers have resorted to spraying various cleaning compounds directly on to the coils to remove the oil which is thickened with dirt. The designers can only view this practice with alarm knowing that, while it may permit a motor or generator to be returned to service for a short time, such cleaning methods can only increase the rate of deterioration of the insulation and shorten the time between the periods of overhaul.

If water or oil is permitted to drop on commutators, flashing generally is the result. Oil on commutators can also penetrate between the interfaces of the mica insulation, softening the structure, permitting distortion and ultimately the failure of the commutator.

A further hazard to the electrical equipment is the use of cleaning compounds for removing the oil film and dirt from the interior of the locomotives and from the trucks. Such cleaners are sprayed on and later removed by hot water or steam jets. In some cases, the steam jet conveys the compound to the surface to be cleaned. The necessity of cleaning, for a number of reasons, one of which is the removal of fire hazard, cannot be questioned. However, proper protection must be given the electrical machinery to prevent the compound and water from being either drawn or driven into the windings of the machines. The cleaning compounds are generally electrolytic in their characteristics and can destroy completely the effectiveness of the creepage surfaces of the insulation. When these cleaning methods are adopted, the electrical machines should be completely covered from the initiation of the cleaning until the locomotive has completely dried out afterward.

It would appear that properly fitted waterproof covers could be made for generators, auxiliaries, blower intake openings and the open rear ends of traction motors.



Water and some cleaning compounds can damage insulation. Fitted covers are recommended for electrical equipment when locomotive interiors are cleaned.

These would furnish protection for the windings while cleaning is in progress and would facilitate a more thorough cleaning of the parts involved.

Annual inspection rules for locomotives require a dielectric test of the insulation. This test should not be applied unless the machines are substantially dry and the dirt and carbon dust have been removed from the creepage surfaces. Generally, the condition of the insulation can be determined by measuring the insulation resistance, particularly if a record of these measurements is kept and compared together with the temperature and humidity existing when the measurements are made. While a wide variation will generally be found in such measurements, a minimum below which it is unsafe to apply the dielectric test, can be found. Conducting films across the creepage surfaces left by inadequate cleaning generally show up readily in the insulation resistance measurements.

Overhaul of the insulation structure consists basically of thorough cleaning, dipping and baking. Various methods of cleaning are used. The steam jet, supplemented by petroleum distillate and a corncob meal blast and, at times, a blast containing a light abrasive is our recommendation. We find less hazard and less damage to the fillers in this method than in any of the others and, particularly, in the use of degreasers. Dipping and baking should be done a sufficient number of times to obtain, by observation, a satisfactory fill and a well-covered surface. The number of dips and bakes depend on the condition of the insulation after thorough cleaning and the characteristics of the varnished used.

The frequency of such overhaul periods comes in for a lot of discussion and debate. It is our opinion that such will vary between two and ten years depending upon the service, the climate and the exposure to dirt and to water. If the machines get soaked with oil, radiator water—usually containing inhibitors—or cleaning compounds they should be removed at once, cleaned thoroughly, dipped in varnish and baked as required.

The second and final part of this article will appear in the June 1954 issue of *Railway Locomotives and Cars*.

Speeds of 151 MPH Reached in French Tests

To determine performance characteristics of passenger trains operating at speeds above the authorized 87 mph maximum, French railroad engineers have conducted a series of highspeed tests.

The tests were made on the lines of the French National Railroads between Dijon and Beaune, a distance of 23 miles. This section is largely tangent track with a few wide curves. The rail weight is 99 lb.

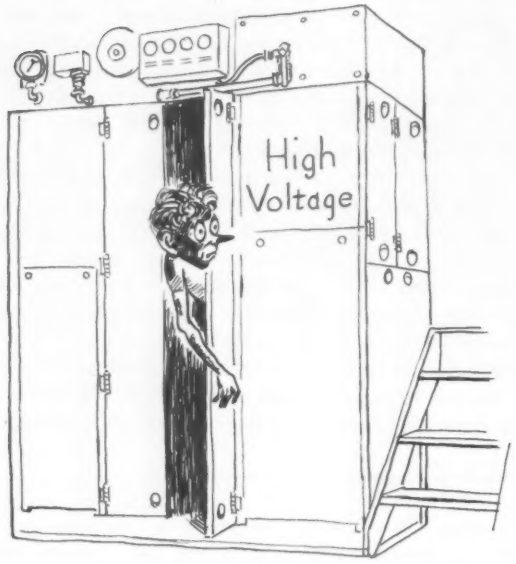
The electric locomotive used has a C-C wheel arrangement and weighs about 118 U. S. tons. For the tests, it was used to haul three passenger cars weighing 40.7 tons each.

A series of tests were made in which the maximum speeds were increased in five increments from 99.4 to 151 mph. Truck-mounted recording devices were used to measure lateral forces against the rail. The accepted maximum lateral force that this track can bear with this locomotive is about 14,500 lb.

The maximum lateral force developed on tanget track was 9,500 lb. This occurred at 147.1 mph and was caused by the third axle of the leading locomotive truck. A lateral force of 14,300 lb. was recorded on a 0.5 degree curve at 124.3 mph. This was the maximum speed run on any of the curved track.

The engineers report that both locomotive and car performance was highly satisfactory and that no trouble was experienced with pantographs. While no increase of regular operating speeds is contemplated, the tests served to show for specific pieces of equipment, the latitude between the speed used for commercial service and the maximum speed possible.

The test train on one of its high speed runs.



Dirt can hide anywhere

Diesel Enemy No. 1

By Gordon Taylor

Webster defines dirt as—"Any foul or filthy substance." We find that he could also have said "dirt is diesel enemy No. 1." Let me tell you about dirt and the diesels.

First, dirt travels under many names and hides in many places. It may be identified as road dust, grit, carbon dust from motor brushes, grindings from brake shoes, mixtures of grease and dirt, or water and dirt.

When the diesel engine was designed with its close fitting parts, there was no space planned for dirt. Consequently, dirt has no place on or in a diesel engine. Neither has it any place in a high voltage electrical system.

Because dirt is hiding in so many spots, any careless action on the part of the maintainer will let it in where it is not wanted. For example:—when an engine is dismantled, the openings to oil lines, and fuel lines, should be covered to keep dirt out.

When engines are being repaired or assembled, openings into the engine should be covered or otherwise protected to keep dirt out. Two cases have come to my attention where engines were being rebuilt in a dust-laden atmosphere near excavation work. The engines were not covered, and in the most recent case a great deal of work had to be done over, at increased cost and delay.

Engine parts laid on the floor or other dirty surface will be certain to pick up dirt, which will later get into the engine unless parts are properly cleaned, and extra needless cleaning costs money. Wrapping paper can be used to good effect to cover dirty surfaces on which parts may be placed.

This article is based on actual experiences of men who operate and maintain diesel-electric locomotives.

Dirt in the lubricating oil will ruin bearings. Dirt in fuel systems will clog fuel line filters. Dirt in engine cylinders will cause stuck rings and scored pistons and liners. This was proved in the recent cases where engines were assembled in a dust-laden atmosphere.

Dirt in Electrical Parts

Dirt in the electrical system is just as much an enemy as in the engine.

If traction motors and generators are not kept clean and free of dirt, carbon dust, and oil, the stage will be set for a flashover. All that is needed for a flashover is a streak of dust or carbon across a string band or on a brush holder porcelain insulator leading from a current conducting part to a motor frame. The leakage path thus set up will permit a high voltage discharge that will destroy insulation and burn commutators.

Such a flashover can easily cause an extra day's delay and much hot dirty work to make the unit fit for service. It is always easier to keep the dirt off motors and generators than it is to clean up a flashover. Why not be smart and keep dirt out?

A little thought on the matter will convince any one that dirt has absolutely no place around a diesel locomotive. It can only cause trouble; therefore, it must be eliminated.

Many of our diesel maintainers worked for years on steam locomotives in roundhouses with dirt or cinder floors. Dirt was not considered an enemy of the steam locomotive, so for that reason many maintainers find it difficult to regard dirt as an enemy of the diesels. The sooner that maintainers understand that dirt is diesel enemy No. 1, the sooner we will start improving diesel performance. It is that simple, so let us eliminate dirt.

Reward

There is a reward for the capture and elimination of diesel enemy No. 1, the same as for any other public enemy. Keep dirt out of diesels and your reward will be less hot, dirty repair jobs to do—and less explaining. Also, you will gain in the pride and satisfaction that comes to one who is master of his job.

Atomic Power Plants on Wheels

Atomic energy power plants, small enough to be transported on railroad cars are one objective of a research program to be undertaken by the Bendix Aviation Corporation.

Such power plants, it is felt, would be particularly desirable for use in disaster areas where rescue operations are always greatly hampered until power is restored. The research program will be undertaken as a result of a study agreement with the Atomic Energy Commission. It will be concerned primarily with new applications of atomic power to non-military projects.

Questions and Answers

Interchange Rules

This is the sixth installment of a new series of questions and answers on the Association of American Railroads Code of Rules Governing the Condition of, and Repairs to, Freight and Passenger Cars for the Interchange of Traffic which may help car men clarify their understanding of the philosophy, intent and requirement of the Interchange Rules. The answers given to the questions are not to be considered interpretations of the rules of Interchange, which can only be rendered by the Arbitration Committee acting officially. The comments, however, will come from a background of intimate association with the application of the rules. Obviously, comments or opinions as of today, may be inapplicable after a revision of the rules or further interpretations by the Arbitration Committee.—Editor.

65-Q.—Does the application of draft gear with friction end pointed backward in car instead of forward in accordance with manufacturers instructions constitute wrong repairs?

A.—Yes. In such cases a defect card should be issued for labor only for correction of wrong repairs.

66-Q.—In stenciling the light weight on container cars, what consideration should be given to the containers?

A.—The light weight stenciling should be the weight of the car without the containers.

67-Q.—Where spring type packing retainer device contacts journal and causes same to become cut or otherwise damaged, is handling line or car owner responsible?

A.—Under present rules such damage is classifiable as a cut journal and therefore handling line is responsible.

68-Q.—Because of the decision in Arbitration Case No. 1759, it has been contended that subsequent billing repair card may be used as valid and conclusive evidence in dispute of correctness of details of previous billing repair card: is this proper in all cases?

A.—No. The decisions in Arbitration Cases 1306 and 1320 directly support the principle that subsequent billing repair card is not necessarily valid evidence to establish the incorrectness of previous repair record. Each case of this kind should be settled on its own merits, taking into consideration the element of time elapsed between the two repair transactions as well as other pertinent details which are not always the same.

69-Q.—What charge may be made for removal of portion of cap screw broken off in pipe bracket and in AB reservoir?

A.—Charge for removal of cap screw broken off in pipe bracket, cylinder or reservoir and the renewal of same should be on the basis of Item 26 of Rule 111, plus additional charge for R. & R. of other cap screws necessary for removal of connecting pipes to drill out broken cap screw in position on car, total charge not to exceed the allowances specified in Item 16 of Rule 111.

70-Q.—What charge should be made for disassembling Hyatt journal roller bearing units account change of wheels?

A.—Allowances in Item 27 of P.C. Rule 21 are set up to permit an additional charge for disassembling or assembling of roller bearing units, when found defective. This charge is in addition to Items 21, 22 and 23 of P.C. Rule 21. If no defect is in existence on roller bearing units no additional charge can be made to allowances specified in Items 21, 22 and 23 of P.C. Rule 21.

71-Q.—Where flooring in refrigerator car is renewed on authority of defect car, may additional charge be made for renewal of heavy tarred felt which is cemented over the regular flooring?

A.—Cement referred to in Item 188 of Rule 107 is cement used on tongue and grooved joints, etc., on conventional wooden floors. The water proof flooring in refrigerator cars is an addition to conventional floor and additional charge for application of same in detail is proper versus carding railroad.

72-Q.—Is car owner or handling line responsible for the cost of C.O.T.&S. of AB air brakes, per Rule 60, account date of previous cleaning being missing along with AB reservoir, due to broken reservoir bracket, part old and progresive defect, owner's responsibility?

A.—Inasmuch as missing reservoir is handling line responsibility as per Rule 58, handling line is required to assume cost of C. O. T. & S. of air brakes.

73-Q.—Under what circumstances would it be proper to issue defect card versus delivering road in interchange where hopper doors on empty open-top cars are open less than 3 in.?

A.—Hopper door open in excess of 3 inches whether securely latched or not is cardable in interchange. Hopper door open to a lesser extent on cars with door fixtures equipped with preliminary position, where there is a possibility of failure to hold door in closed position, is also cardable.

Schedule 24 RL Air Brakes

1700-Q.—Describe the A-2 Circuit Tester.

A.—It is a small portable device weighing approximately 35 pounds, using the same internal arrangements for checking the train line circuits as does the SC-2 A type of circuit checking equipment.

1701-Q.—Describe the A-2 Circuit Tester further.

A.—This tester contains two Wheatstone bridges and has connections for a power source and for the train line wires. A selector switch is provided for different voltages and to turn the tester on and off. This switch is set to correspond to the same voltage as the particular supply voltage used. A temperature dial is also provided and should be set for ambient air temperature.

1702-Q.—How is the A-2 Circuit tester connected?

A.—Connections are made from the circuit tester to a power source (generally available along the track in the coach yards) and to the train line wires. The selector

switch is then turned from the Off position to either the 110 volt D.C., the 64 volt D.C. or the 32 volt D.C. position, depending upon the supply voltage used. The temperature dial is set to outside temperature.

1703-Q.—What action should follow?
A.—In this position of the selector switch the application and release dials are maneuvered until the needles on the meters corresponding to each dial read zero. The dial setting at the zero meter reading should be in agreement with the number of vehicles in the train being checked.

1704-Q.—What further testing can be made?
A.—Further testing of branch wires to the magnet valves, and of plug connections, can be made by maintaining the voltage in the train line wires through the circuit tester and jiggling the branch wires or plug connection by hand.

1705-Q.—What would indicate a poor connection?
A.—Any movement of the branch line wire or plug connector which causes a needle fluctuation on the circuit tester indicates a poor connection in that particular wire or plug connector.

Detail Description of Operation

1706-Q.—Why is it necessary to show the detailed information which is to follow?
A.—For those who are interested in details of the equipment and who are responsible for its maintenance and repairs, the previous information is hardly sufficient. In order to simplify the explanation, a number of circuit diagrams have been made.

1707-Q.—Describe the first or these diagrams.
A.—Diagram Plate 5 is similar to that shown previously on Plate 3 with the exception that identifying characters the same as those used on the complete circuit diagram have been added.

1708-Q.—Referring to Plate 5, how are the various relay contacts indentified?
A.—By such characters as B1, C2 etc.

1709-Q.—What do these characters indicate?
A.—These identifying characters indicate the physical location of the contacts.

1710-Q.—What do the letters indicate?
A.—The letters A, B, C etc., indicate the location of the contact stacks on each relay; the *A* stack being at the left when looking at the front of the relay, the *B* stack being second from the left etc.

Diesel-Electric Locomotives*

Water Pump Discharge Elbows

1010-Q.—For what purpose are the discharge elbows?
A.—Two discharge elbows connect the discharge side of the water pump to the water headers located in the engine frame.

1011-Q.—What is the action when removing these elbows?
A.—Remove capscrews and washers from water headers. Remove bolts and nuts from pump flange and elbow flanges and remove elbows.

1012-Q.—What inspection should be made?
A.—Inspect interior of elbows for cleanliness and check gaskets, renewing same if necessary.

1013-Q.—What operations are necessary for installation of discharge elbows?
A.—Replace gaskets and reverse procedure for removal.

Turbosupercharger Support

1014-Q.—Describe the turbosupercharger support and its purpose.
A.—This device, made of welded steel components, encloses the top of free end casing, and provides mounting surfaces for turbosupercharger, governor, air intake elbow, oil catcher and turning device.

1015-Q.—What items must be removed to permit removal from the free end casing and engine frame?
A.—Turbosupercharger and fittings. Governor and control linkage. Water discharge elbows. Oil catcher (extension shaft) and air manifold elbow.

1016-Q.—What must be done to remove the support from the engine?
A.—Remove dowels from support with puller. Remove self locking nuts from engine frame studs and remove capscrews. Lift turbosupercharger support from free end casing with hoist.

1017-Q.—What attention should be given the support after removal?
A.—Inspect gasket and renew if necessary. Clean interior and exterior of support with cleaning fluid and surface inspect.

1018-Q.—What precaution should be taken when re-installing the support?
A.—Particular attention should be given to reduce the possibility of cutting or otherwise damaging the gasket.

1019-Q.—Describe the operation.
A.—First, position the gasket in the cylinder block, position the turbosupercharger support, raise the support slightly and then position the free end gasket.

1020-Q.—Describe the operation further.
A.—Re-insert dowel pins. If a new support, align by centering with the crankshaft extension bore of the free end casing and dowel. Secure with capscrews and lock washers and self locking nuts.

Turning Device

1021-Q.—What is the function of the turning device?
A.—To turn the crankshaft for maintenance and overhaul.

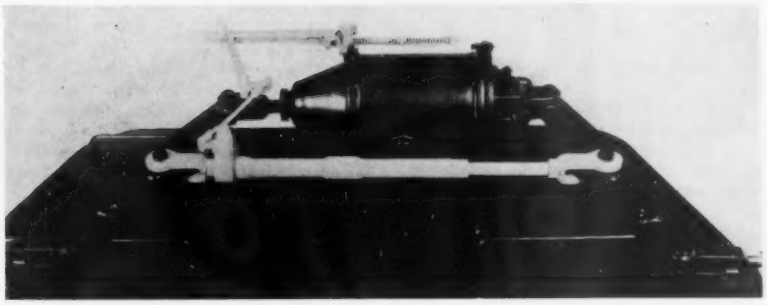
1022-Q.—What sort of an arrangement is the turning device?
A.—A worm and gear arrangement—Figs. 2-4 and 3-4

1023-Q.—Where is the worm located?
A.—In a bracket secured to the turbosupercharger support.

1024-Q.—Describe the worm further.
A.—The worm has a shaft extending through the bracket with standard hex heads on both ends for the application of a socket wrench so it can be turned by a ratchet handle or an air motor.

* This series of questions and answers relate specifically to the Alco-G.E. Diesel electric locomotives. The figure numbers and references, by number, to diagrams, etc., relate to the current edition of the Alco-G.E. operating and maintenance manual.

NEW DEVICES



Automatic Slack Adjuster For Freight Cars

A device, the Franklin automatic brake slack adjuster was recently developed by the Franklin Balmar Corporation, Baltimore 11, to meet the demands for automatic control of freight-car brake cylinder piston travel during brake shoe life. The product has tentative AAR approval and permission for application to cars either on line or in interchange service. The manufacturer states that the brake slack adjuster results in better brake performance and elimination of manual adjustments during brake-shoe life.

Two types are offered—the type G for general type of brake cylinder and lever adjustment usually found on cars other than hoppers and the Type H for hopper cars. While the two types differ most of the parts are interchangeable

The principle of operation is that of a ratchet and pawl working on an adjusting screw which effects a change in length of the slack adjuster. The Type G is installed in the cylinder lever tie rod while the Type H is installed in the pull rod at the bottom connection of the cylinder lever.

Each time a brake application is made, the housing carrying the pawl is rotated through an angular distance proportionate to the push rod travel by means of levers connecting to the brake-cylinder push rod. The pawl housing rotates on the application stroke without rotating the ratchet. If the piston travel is 8 in. or less, the pawl will not travel far enough to engage a tooth on the ratchet. Therefore, on the release stroke no take-up will be made. If the push rod travel is more than 8 in., the angular pawl travel is increased so that a ratchet tooth is engaged. In this case a take-up adjustment is made on the release stroke, shortening the slack adjuster by an amount corresponding to one-seventh turn of the adjusting screw housing. With the average cylinder levers, this mans approximatly ⅛ in. of piston travel per adjustment.

For changing brake shoes a simple reset mechanism is provided. It is not necessary for a maintainer to go between the rails and no tools are needed. Neither is it required to disconnect brake rigging to replace worn brake shoes as the reset mechanism provides a quick means for obtaining the desired slack in the rigging to allow for brake-shoe renewal. This reset mechanism can also be used for bringing piston travel close to the predetermined figure before returning car to service.

The adjuster with screw housing, head, pawl, pawl housing, and cylinder lever jaw is furnished assembled. Levers, reset lever bearing pin, bracket, etc., are shipped disconnected from the adjuster. The device is protected against the entrance of dirt and foreign matter and is said to give years of service without requiring renewal of parts or repairs. It does not require lubrication between repair periods. Prototype models have been in service three years without attention or lubrication.

Heavy Duty Pipe Wrench

Rugged duty pipe wrenches, in a complete range of sizes from 6 to 48 in., have been designed for heavy duty applications by the Toledo Pipe Threading Machine Co., Toledo, Ohio.

These wrenches feature an easy-action nut and spring which is said to assure quicker, easier setting of jaws. They are equipped with an improved handle design that permits a better hand grip. Handles are painted red.

■

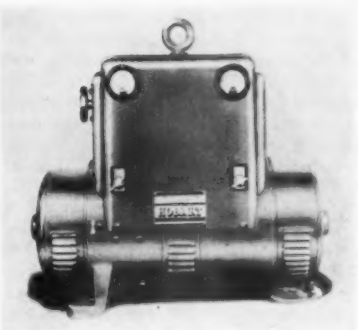
Orlon Work Clothes

Shirts and trousers made from Du Pont Orlon by Worklon, Inc., New York, have cut replacement expenses especially when worn in plating rooms. They are said to prevent excesssive damage through the splashing of acid plating solutions and caustics.

Previously, one concern reported that the cost of ordinary work clothing with acid burns became unserviceable in one week. Now, they are in good condition after more than six months service.

Orlon workclothes wash easily and dry quickly are acid resistant and durable under extremely damaging conditions around railroad shops.

■



Constant-Voltage D.C. Arc Welder

A constant voltage type d.c. arc welder designed for welding with inert-gas-shielded-arc, the submerged arc, and other automatic processes is being announced by Hobart Brothers Company, Troy, Ohio.

The hand wheel on the side of the control cabinet lets the operator set the machine for the desired arc voltage, which remains constant at varying current values. This is made possible by separate excitation and compounding to provide a very high short circuit current value. As soon as the welding wire strikes the work, enough current then flows to cause the arc voltage to correspond to the pre-set generator voltage. When used with a process wherein the wire is fed continuously into the weld, the machine automatically controls the current by maintaining the voltage at the established value, without regard to the speed at which the wire is fed to the arc.

The oversize exciter provides full 1-kw. 110-volt d.c. power in excess of that required for excitation purposes. A double receptacle on the side of the control cabinet makes this power available for use in operating certain types of automatic welding equipment.

The machines are available in three rated capacities of 400, 600 and 900 amp. for operation from a.c. or d.c. electric power supply.

Non-Metallic Underground Cable

A new Flamenol Type UF underground feeder cable has been announced by General Electric's Construction Materials Division, Bridgeport 2, Conn. The cable is said to give dependable underground wiring and to be easy to handle and install because of its light weight. It is available with one, two, or three conductors and is recommended for installation in accordance with Article 339 of the National Electrical Code.

Single conductor cable is available in sizes No. 14 through No. 4 AWG and is listed by Underwriters' Laboratories, Inc., as Type UF. Two- and three-conductor cables are available in sizes No. 14, 12 and 10 AWG and are listed as Type UF and Type NMC.

Backstand Idler

Designed for heavy-duty production grinding, as well as for intermittent light polishing jobs, the backstand idler permits belts of the same length to be employed with contact wheels of various diameters. This attachment, the 61, for all types of wall, bench and floor, coated abrasive backstand grinding and polishing operations, is manufactured by the Coated Products Division, the Carborundum Company, Niagara Falls, N.Y.

Because of belt tracking mechanism and tension adjustments, belts ranging in widths from ½ to 8 in. can be used. The tracking device eliminates the need for center alignment between idler pulley and contact wheel minimizing downtime during contact wheel change-overs. A linkage-tape arrangement permits finger-tip manual adjustment of tension and tracking.

The device is available in two models, No. 432 for floor stand operations, and No. 431, a smaller unit for wall, bench or floor installation. Each model is available as an individual unit or as part of a complete backstand installation.

■

Quartz Infrared Lamps

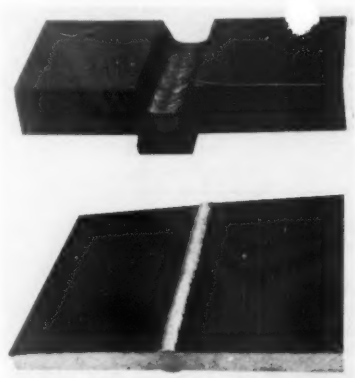
General Electric Company Lamp Division, Nela Park, Cleveland, Ohio, has announced two infrared lamps of radically new design. These lamps have bulbs of tubular quartz, only ⅜ in. in outside diameter. They are capable of delivering over three times the energy concentration provided by the reflector type 375-watt R40 infra-red lamp.

Quartz will withstand high temperature and thermal shock. Even when heated to a cherry red, the slender tubular quartz bulb used in the new lamps may be doused in water without cracking.

Because of this characteristic of quartz, the coiled tungsten filament has been designed to reach the hitherto unattainable value of 100 watts per inch of lighted length of lamp. As a result, the lamps are appropriate for those applications requiring energy concentrations which have not been attainable in the past. These include such uses as paint drying, space heating,

food thawing, and cooking. The small bulb diameter permits use in compact trough reflectors which concentrate the radiation wherever it may be most needed.

■



Powdered Metal for Electrode Coatings

The Lincoln Electric Company, Cleveland, has announced the second electrode in its newly developed line of electrodes with powdered metal in their coatings. Called Jetweld 2, the Electrode is designed for welding butt and deep-groove joints. It is a companion electrode to Jetweld 1, designed for welding horizontal and flat fillet joints.

These electrodes with powdered metal in their coatings are claimed to be a radical departure from all former electrode designs.

Certain operating difficulties said to be inherent in all conventional electrodes, the manufacturer states, are overcome by powdered metal coatings. First, an additional source of metal is available to permit higher deposition rates at usable currents and, second, the problems created by the excessive amount of heat in the arc are eliminated. Powdered metal in the coating is the additional source of metal, and the excess heat available in the arc is used to melt this metal. Faster speeds are thus made possible without too much penetration, gouging of the parent metal, undercutting, spatter, overheating of the electrode coating or other difficulties associated with high current production welding.

■

Battery-Powered Stud Welder

A portable battery unit supplying independent power for welding studs up to ½-in. base diameter is offered by KSM Products, Inc., Merchantville, N. J. This unit is recommended for stud welding where no power lines are available or when existing lines are unable to handle stud welding current in addition to their regular load. Completely integrated and independent of power lines, except for recharging, the unit may be used to operate any electrical equipment within its power capacity.

A tap selector switch, calibrated in weld-base diameters, regulates current supply. An *OFF* position eliminates external terminal shortcircuiting when the unit is not in use. Output terminals for connections to the control box consist of two threaded studs and wing nuts; an ammeter indicates charging current, and a circuit-breaker protects equipment from excessive charging current.

Twelve heavy-duty storage batteries of 150-amp-hr rating are kept charged, when connected to a 115-volt, 60-cycle, single-phase a-c source (15-amp line minimum), by an integral automatic charger which test-checks open-circuit battery voltage every 10 minutes and charges when termi-

(Continued on page 94)

NEWS

Copper Penetration of Car Journals—A Correction

The name of the author—E. B. Fields, engineer of tests, Atchison, Topeka & Santa Fe—was inadvertently omitted from the article on Copper Penetration of Car Journals beginning on page 58 of the April issue.

B&O Engineers Form "Steam Runners' Society"

"The Society for the Preservation of Steam Locomotives and the Men Who Ran Them" was formed a few months ago by a group of Baltimore & Ohio locomotive engineers at Newark, Ohio. As told in the March issue of the B&O Magazine, with the diesels "coming on with a rush," the men felt that in a few years the steam locomotive will be relegated to the past and that those who had spent much of their lives on the steamers should have some memento to preserve the record of their service. "The Steam Runners' Society," as it is called for short, thus came into being, and a certificate of membership was designed.

Certificates which at first were issued locally, with no thought of outside distribution, were proudly displayed by the recipients at the recent Brotherhood of Locomotive Engineers convention at Cleveland. As a result, requests for membership have come in from all parts of the United States, Canada, Alaska, Mexico, the Canal Zone, and countries overseas. At the time of printing the March issue of the B&O Magazine, over 10,000 requests for membership had been received.

Many railroad officers cherish the certificates as mementoes of their earlier days at the throttle. Any engineer with steam locomotive experience may apply for membership by writing to L. E. Schwartz, 100 Oakwood avenue, Newark, Ohio, or J. R. Gatten, 249 Lawrence street, Newark. Membership entails no dues or obligations. A charge of $1 is made to cover printing and mailing costs for each certificate.

GN Modernizing Shops at Hillyard

A $675,000 program of modernization at Hillyard (Spokane), Wash., shops will provide the road with its largest and most complete diesel repair and overhaul facilities west of Havre, Mont. The work will include conversion of a portion of the present machine shop for diesel servicing and repair; extension of the present crane-way in the machine shop; installation of a drop table; installation of an overhead monorail between the converted portion of the machine shop and the present storehouse; construction of a new foreman's office; construction of a diesel wash rack and necessary facilities; installation of new fueling and sanding facilities; and rearrangement of trackage.

The shops will be devoted primarily to

ORDERS AND INQUIRIES FOR NEW EQUIPMENT PLACED SINCE THE CLOSING OF THE APRIL ISSUE

Diesel-Electric Locomotive Orders

Road	No. of units	Horsepower	Service	Builder
Central of New Jersey	7[1]	2,400	Passenger	Fairbanks, Morse

Freight-Car Orders

Road	No. of cars	Type of car	Builder
North American Car Corp.	275[2]	40-ton refrigerator	Pacific Car & Fdry.
Texas & Pacific	200[3]	50-ton box	Company shops
	15	Caboose	Company shops

Passenger-Car Orders

Road	No. of cars	Type of car	Builder
Central of New Jersey	4[4]	RDC-1	Budd Co.
Union Pacific	10[5]	Observation dome	American Car & Fdry.
	5[5]	Dome coaches	American Car & Fdry.
	5[5]	Dome diners	American Car & Fdry.

[1] "Train Master" units. Approximate cost, $1,700,000.
[2] For delivery beginning in August.
[3] The T&P has been authorized to purchase materials for these cars which are to be built during 1955. Fifty box cars will be equipped with General American-Evans "DF" loading equipment.
[4] Approximate cost, $607,000. Now in operation.
[5] In addition to 15 dome cars already on order. Deliveries scheduled to begin in November and to continue into second quarter of 1955.

SUMMARY OF MONTHLY HOT BOX REPORTS

	Foreign and system freight car mileage (total)	Cars set off between division terminals account hot boxes			Miles per hot box car set off between division terminals
		System	Foreign	Total	
July, 1950	2,745,932,894			23,957	114,619
August, 1950	2,937,455,020	7,422	15,490	22,912	128,206
September, 1950	2,974,297,739	6,541	12,881	19,422	153,141
October, 1950	3,165,997,915	4,343	8,935	13,278	238,439
November, 1950	2,868,871,913	2,536	5,331	7,867	364,672
December, 1950	2,813,042,212	2,278	5,968	8,246	341,140
January, 1951	2,840,847,511	2,870	8,436	11,305	251,269
February, 1951	2,425,226,454	4,528	14,063	18,591	130,452
March, 1951	3,063,173,942	3,667	10,078	13,745	222,857
April, 1951	2,996,562,763	3,702	8,914	12,616	237,521
May, 1951	3,013,634,782	5,631	13,737	19,368	155,599
June, 1951	2,874,873,495	7,074	15,376	22,450	128,057
July, 1951	2,768,920,095	8,886	18,823	27,709	99,929
August, 1951	3,009,371,111	9,023	19,092	28,115	107,038
September, 1951	2,925,570,545	6,472	13,565	20,037	146,008
October, 1951	3,116,490,095	4,131	9,053	13,184	236,384
November, 1951	2,939,503,144	2,022	4,405	6,427	457,368
December, 1951	2,752,316,133	2,130	5,398	7,528	365,611
January, 1952	2,824,298,630	3,208	7,197	10,405	271,437
February, 1952	2,809,162,671	2,723	6,473	9,196	305,477
March, 1952	2,943,812,727	2,594	5,877	8,471	347,517
April, 1952	2,766,313,714	3,826	7,759	11,585	238,784
May, 1952	2,918,508,445	6,020	10,938	16,958	172,102
June, 1952	2,672,512,889	8,466	14,495	22,961	116,394
July, 1952	2,575,298,912	10,566	15,833	26,399	97,553
August, 1952	2,924,917,122	11,658	17,535	29,193	100,192
September, 1952	2,931,129,734	7,536	13,608	21,144	138,627
October, 1952	3,093,990,289	4,058	8,053	12,111	255,469
November, 1952	2,984,101,808	2,198	4,501	6,699	445,455
December, 1952	2,869,928,617	1,742	3,632	5,374	534,040
January, 1953	2,828,906,282	2,219	4,123	6,342	446,059
February, 1953	2,625,563,462	2,111	4,059	6,170	425,537
March, 1953	2,904,227,804	2,696	6,077	8,769	331,192
April, 1953	2,850,752,648	3,383	6,435	9,818	290,359
May 1953	3,013,610,843	5,892	11,433	17,325	173,945
June, 1953	2,926,001,360	8,537	15,296	23,833	122,771
July, 1953	2,925,317,024	9,342	15,775	25,117	116,467
August, 1953	2,971,020,484	8,638	14,160	22,798	130,319
September, 1953	2,822,222,832	6,083	10,195	16,278	173,376
October, 1953	3,042,558,922	3,863	6,493	10,356	293,796
November, 1953	2,788,773,285	1,987	3,404	5,391	517,301
December, 1953	2,656,063,018	1,581	2,550	4,131	642,958
January, 1954	2,583,485,918	3,082	3,797	6,879	375,561

maintaining freight units and will be equipped to make engine and generator changes and heavy body repairs. All remaining steam power on the GN is confined to lines east of Havre.

It is contemplated that a portion of the present roundhouse will be razed and the remaining part converted for repair of work equipment. The present shop where this is carried on is expected to be converted for industrial use and the employees transferred to Hillyard.

SELECTED MOTIVE POWER AND CAR PERFORMANCE STATISTICS

FREIGHT SERVICE (DATA FROM I.C.C. M-211 AND M-240)

Item No.		Month of December		12 months ended with December		January	January
		1953	1952	1953	1952	1954	1953
3	Road locomotive miles (900) (M-211):						
3-05	Total, steam	8,657	15,071	142,863	203,765	7,883	13,489
3-06	Total, Diesel-electric	31,470	29,656	375,352	331,045	31,263	30,196
3-07	Total, electric	614	683	8,589	9,000	623	711
3-04	Total, locomotive-miles	40,830	45,459	527,650	544,233	39,840	44,457
4	Car-miles (000,000) (M-211):						
4-03	Loaded, total	1,439	1,576	19,756	19,805	1,474	1,626
4-06	Empty, total	935	971	11,055	10,807	867	906
6	Gross ton-miles-cars, contents and cabooses (000,000) (M-211):						
6-01	Total in coal-burning steam locomotive trains	15,690	25,222	259,933	357,782	14,967	23,761
6-02	Total in oil-burning steam locomotive trains	3,014	6,961	67,959	99,691	2,623	5,724
6-03	Total in Diesel-electric locomotive trains	83,514	79,782	1,044,854	919,147	84,725	82,988
6-04	Total in electric locomotive trains	1,694	1,827	24,326	24,859	1,842	1,932
6-06	Total in all trains	104,207	113,951	1,399,875	1,402,956	104,390	114,610
10	Averages per train-mile (excluding light trains) (M-211):						
10-01	Locomotive-miles (principal and helper)	1.02	1.03	1.03	1.03	1.02	1.03
10-02	Loaded freight car-miles	37.90	37.70	40.50	39.80	39.80	39.70
10-03	Empty freight car-miles	24.60	23.30	22.70	21.80	23.40	22.10
10-04	Total freight car-miles (excluding caboose)	62.50	61.00	63.20	61.60	63.20	61.80
10-05	Gross ton-miles (excluding locomotive and tender)	2,742	2,729	2,873	2,821	2,816	2,795
10-06	Net ton-miles (000)	1,188	1,216	1,301	1,296	1,244	1,262
12	Net ton-miles per loaded car-mile (M-211)	31.40	32.20	32.10	32.50	31.30	31.80
13	Car-mile ratios (M-211):						
13-03	Per cent loaded of total freight car-miles	60.60	61.90	64.10	64.70	63.00	64.20
14	Averages per train hour (M-211):						
14-01	Train miles	18.70	18.10	18.20	17.60	18.80	18.30
14-02	Gross ton-miles (excluding locomotive and tender)	50,806	48,958	51,750	49,113	52,304	50,516
14	Car-miles per freight car day (M-240):						
14-01	Serviceable	41.20	44.10	45.40	45.00	40.70	43.80
14-02	All	39.30	42.10	43.20	42.80	38.80	41.80
15	Average net ton-miles per freight car-day (M-240)	747	838	890	901	763	852
17	Per cent of home cars of total freight cars on the line (M-240)	55.10	47.00	47.10	43.50	53.60	47.40

PASSENGER SERVICE (DATA FROM I.C.C. M-213)

3	Road motive-power miles (000):						
3-05	Steam	3,428	6,366	48,713	79,703	2,895	5,364
3-06	Diesel-electric	21,721	20,615	243,606	225,709	21,288	20,287
3-07	Electric	1,574	1,727	18,281	19,444	1,496	1,657
3-04	Total	26,723	28,708	310,601	324,864	25,680	27,309
4	Passenger-train car-miles (000):						
4-08	Total in all locomotive-propelled trains	276,750	295,716	3,141,066	3,251,540	258,010	276,114
4-09	Total in coal-burning steam locomotive trains	18,625	35,570	269,337	416,131	15,200	29,458
4-10	Total in oil-burning steam locomotive trains	12,460	23,537	170,119	293,620	8,997	18,134
4-11	Total in Diesel-electric locomotive trains	228,031	217,463	2,498,397	2,325,877	217,150	209,956
12	Total car-miles per train-miles	10.04	10.11	9.78	9.78	9.70	9.84

YARD SERVICE (DATA FROM I.C.C. M-215)

1	Freight yard switching locomotive-hours (000):						
1-01	Steam, coal-burning	416,236	688,324	6,877	9,482	373	640
1-02	Steam, oil-burning	63,080	138,471	1,201	1,958	53	118
1-03	Diesel-electric[1]	3,402	3,455	41,291	38,332	3,321	3,425
1-06	Total	3,898	4,305	49,601	50,053	3,759	4,208
2	Passenger yard switching hours (000):						
2-01	Steam, coal-burning	18	26	236	324	14	24
2-02	Steam, oil-burning	4	7	74	122	4	5
2-03	Diesel-electric[1]	281	285	3,095	3,093	268	269
2-06	Total	335	354	3,786	3,940	317	334
3	Hours per yard locomotive-day:						
3-01	Steam	5.40	6.70	6.70	7.00	4.90	6.30
3-02	Diesel-electric	15.40	16.50	16.10	16.20	15.00	16.20
3-05	Serviceable	14.30	14.70	14.90	14.40	14.10	14.50
3-06	All locomotives (serviceable, unserviceable and stored)	12.50	13.00	13.20	12.50	12.20	12.70
4	Yard and train-switching locomotive-miles per 100 loaded freight car-miles	1.87	1.88	1.74	1.75	1.77	1.78
5	Yard and train-switching locomotive-miles per 100 passenger train car-miles (with locomotives)	.75	.74	.75	.75	.76	.75

[1]Excludes B and trailing A units.

SUPPLY TRADE NOTES

THE SAFETY CAR HEATING & LIGHTING CO.—*John F. Runge*, manager of the New York sales office since 1944, has been appointed electrical engineer.

J. F. Runge

H. S. Clarke

J. E. Zulauf

Harry S. Clarke, sales representative at Chicago since 1948, has been appointed manager of the New York sales office. *John E. Zulauf*, service engineer in the Eastern district, has been transferred to the Chicago office.

(Continued on page 88)

Supply Trade Notes

(Continued from page 86)

MAGNUS CHEMICAL COMPANY. — *E. H. Peterson* has been appointed sales manager at Garwood, N.J.

Mr. Peterson has been with Magnus

E. H. Peterson

since 1947 in engineering and sales capacities. He was appointed assistant to the president in 1952.

■

A. M. BYERS COMPANY.—*John W. Rapp* has been appointed railway sales representative—central district, at Chicago and St. Louis.

■

SPERRY RAIL SERVICES—*S. A. Thompson*, assistant sales manager, has been named railroad sales manager.

■

JOSEPH DIXON CRUCIBLE COMPANY.—*Roland J. La France* has been appointed manager, paint sales division.

■

OKONITE COMPANY. — *The Okonite Company of Passaic, N.J.*, announces that, effective April 1, The *Okonite-Callender Cable Company, Inc.*, a wholly-owned subsidiary, has been merged with the Okonite Company.

■

BRIGGS FILTRATION COMPANY. — The following changes have been made in the industrial sales organization:

H. K. Woodward, formerly regional manager, north eastern and north central regions, has been appointd general industrial sales manager. *John D MacGuffin* has been named regional manager of the north central region, with headquarters in Chicago, and *C. J. DeVries*, regional manager of the south eastern region. *R. A. Howland* continues as regional manager of the south central region.

■

ELECTRIC STORAGE BATTERY COMPANY.—*Charles L. Bend*, Denver sales engineer, has retired. Mr. Bend had been associated with Exide since 1922.

■

ANACONDA WIRE & CABLE CO. — *Jack Saunders* has been appointed manager of a new State of Florida sales district, with headquarters in Tampa. *Robert W. Carmichael* has been named to assist Mr. Saunders. *Frank D. Dickey* has been appointed manager of the San Francisco dis-

trict. He succeeds *Lee Hayward*, who has resigned. Mr. Dickey will be assisted by *Dick Riley*, who has been transferred from Cincinnati. *Howard Davies* has been appointed salesman for the district office in Pittsburgh; and *Thomas F. Jackson* has been appointed to the Chicago district office.

■

KSM PRODUCTS, INC.—*H. L. Wagner* has been appointed special consultant to the KSM technical research group at Merchantville, N.J., where a new laboratory building is under construction.

■

BULLARD COMPANY.—*C. Harold Anderson* has been appointed chief engineer. Mr. Anderson has been assistant chief engineer since May 1950.

C. H. Anderson

■

NATIONAL MALLEABLE & STEEL CASTINGS CO.—*T. K. Sanders* has been appointed field engineer at National's new Technical Center in Cleveland. Mr. Sanders has been engineer in charge of physical testing for the Association of American Railroads.

■

LINCOLN ELECTRIC COMPANY. —*Jack Jaso* has been assigned to the Chicago district as an application engineer. *Walter Rockway* is serving industry in the Cincinnati district. *Chester Shira* is an application engineer for the Jacksonville, Fla., district.

■

AMERICAN AIR FILTER COMPANY. —*Howard M. Fitch*, general manager of the Herman Nelson Division, Moline, Ill., has been elected a vice-president of American Air Filter, with headquarters at Louisville, Ky. Mr. Fitch served as a sales engineer, production manager, manager of the legal and patent department, and as assistant to the executive vice president, before becoming manager of the Herman Nelson Division in 1953.

■

CLARK EQUIPMENT COMPANY, Ross Carrier Division.—Clark has established a Ross Carrier Division for its Ross line of straddle carriers. The Ross Carrier Company wa acquired by Clark last May; since then, the carriers have been marketed through the sales organization of Clark's Industrial Truck Division, and will continue to be so handled. *A. H. Pierce* has been

(Continued on page 90)

Supply Trade Notes

(Continued from page 89)

appointed manager of the new division; *Roger Spencer* will continue as chief engineer, and *Jack W. Ross* will supervise sales information activities for the division from Benton Harbor, Mich.

■

ARMCO STEEL CORPORATION—Construction has begun on an expansion of Armco's fabricating division at Middletown, Ohio, which will add 32,000 sq ft of floor space. Armco has acquired *Southwest Steel* a steel fabricating company with plants in Houston. *Russell L. Jolley*, formerly president, will continue in charge of the business, which will be operated as a wholly owned Armco subsidiary.

■

PYLE-NATIONAL COMPANY. — *William G. Gray*, formerly asociated with Pittsburgh Steel Company and Union Asbestos & Rubber Co., has been appointed manager railway sales for Pyle-National.

■

NICKEL CADMIUM BATTERY CORPORATION.—*Theodore Ulrich* has been appointed Chicago district manager, sales and service. He was previously sales engineer for the Minnesota Mining Company.

Obituary

HARRY A. WOLFE, division sales manager—railway department, of the Lehon Company, at Chicago, died March 25.

PERSONAL MENTION

Atlantic Coast Line

JOHN C. FOSTER, general diesel supervisor at Wilmington, N.C., appointed general foreman at Montgomery, Ala.

VAN WILLIAMS, JR., general foreman at Montgomery, Ala., appointed master mechanic at Fitzgerald, Ga., with jurisdiction over Western Division.

M. E. SMITH appointed road foreman of engines, with headquarters at Ocala, Fla.

D. E. PITTMAN appointed assistant road foreman of engines, with headquarters at Manchester, Ga.

F. A. GRAY appointed general foreman at Savannah, Ga.

Atchison, Topeka & Santa Fe

WILLIAM S. LAMMERS, mechanical valuation engineer at Topeka, Kan., has retired.

MELBERT O. CHARLSON, valuation assistant, appointed mechanical valuation engineer at Topeka, Kan.

Bessemer & Lake Erie

W. H. ROMICH, general locomotive foreman at Greenville, Pa., has retired.

O. J. WATHAN, JR., diesel electrical supervisor, appointed assistant general locomotive foreman.

H. E. MATHAN, assistant general locomotive foreman, appointed general locomotive foreman.

Illinois Central

GEORGE J. LEHNERER, superintendent car department at Chicago, appointed assistant mechanical and research engineer.

LAWRENCE H. SCHIERBECKER, assistant superintendent car department, appointed superintendent car department at Chicago.

Indiana Harbor Belt

ROBERT A. JACOB, appointed apprentice instructor at Gibson, Ind.

Minneapolis, St. Paul & Sault Ste Marie

W. O. AYERS, *enginehouse* foreman at Minot, N.D., appointed general mechanical inspector at Minneapolis.

New York Central

F. T. KINGSTON appointed assistant industrial engineer-equipment, with headquarters at New York.

G. S. WIELAND, appointed road foreman of engines at Cleveland.

L. A. JORDAN appointed road foreman of engines at Cleveland.

T. C. BOURNE, appointed district car inspector at Cleveland.

E. J. BURDUE appointed road foreman of engines at Detroit.

H. F. UDELL appointed road foreman of engines at Detroit.

G. S. MOORE, JR., appointed road foreman of engines at Chicago.

K. C. BOLING appointed assistant district supervisor of electrical equipment at Indianapolis.

R. W. STONECYPHER appointed road foreman of engines at Chicago.

E. C. SCOVILLE, shop and equipment inspector at Collinwood, Ohio, has retired.

(Continued on page 93)

Personal Mention

New York Central

(Continued from page 91)

A. A. LAURIN appointed shop and equipment inspector at Collinwood, Ohio.

T. E. WILDER appointed general inspector at New York.

K. M. B. STODDARD, chief road foreman of engines, appointed district road foreman, with headquarters at Syracuse.

G. E. VAN DUESEN, chief road foreman of engines, appointed district road foreman, with headquarters at Albany.

G. H. MILLER, road foreman of engines at Buffalo, appointed district road foreman, with headquarters at DeWitt, N. Y.

L. F. BENZ, chief road foreman of engines, appointed district road foreman, with headquarters at Buffalo.

F. C. HATCH, chief road foreman of engines, appointed district road foreman, with headquarters at Boston.

W. H. FORTNEY appointed district road foreman of engines at Indianapolis.

W. E. HEROLD appointed district supervisor of electrical equipment at Indianapolis.

Norfolk & Western

VERNON R. MACKIE, night foreman Roanoke (Va.) shops coach yard, appointed foreman Norfolk (Va.) coach yard.

S. P. BREWER, assistant foreman Roanoke (Va.) coach yard, has retired.

E. R. PAYNE, Norfolk (Va.) coach yard foreman, appointed night foreman Roanoke (Va.) shops coach yard.

BRANDOL W. WEST appointed assistant foreman Roanoke (Va.) coach yard.

EVERETT FARISS, division car inspector, Eastern General division, has retired.

W. H. MORRIS, car foreman at Williamson, W. Va., appointed division car inspector, Eastern General division.

L. T. BROWN, assistant car foreman at Williamson, W. Va., appointed car foreman.

B. C. COOK, gang foreman, Shaffers Crossing car department, appointed car foreman at Clare, Ohio.

R. E. THOMPSON, car foreman at Clare, Ohio, appointed assistant car foreman at Williamson, W. Va.

Pennsylvania

H. W. COLLINS, acting foreman car repairs, appointed foreman car repairs, Connemaugh division.

(Continued on page 94)

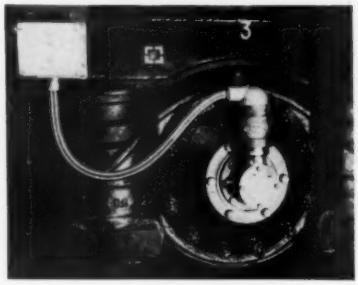
NEW DEVICES

(Continued from page 84)

nal voltage is below normal. Access to 12 batteries, confined by steel partitions to prevent accidental damage to other sections of the unit from battery acid, is made easy by piano-hinged covers on both sides of the unit.

Easy access to control mechanism, charger, and storage compartment for stud-welding control unit, guns, accessories, and studs is made possible by a piano-hinged top held in full open position by a durable chain. The unit is available either without wheels or with a choice of steel wheels or solid or pneumatic rubber-tire wheels, and is finished in red baked enamel.

■



Electric Remote Drive Speed Recorder

A speed indicating and recording device just made available by the Matisa Equipment Corporation, 224 S. Michigan, Chicago 4, features electric transmission between the pickup portion on the journal box and the indicating portion in the cab. The electric remote drive which connects the two points together is simple to install,

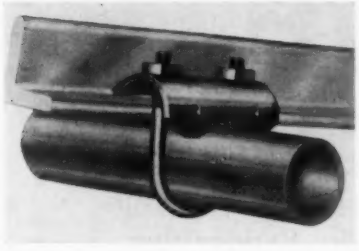
comprising an electric cable with synchronous motors at either end to measure the rotary motions of the transmitter at the axle on the indicator in the cab.

The instrument indicates speed, time of day in hours and minutes, and the distance traveled. It records these three items plus the time spent traveling and the time spent standing still. Where desired, additional features can be incorporated to record one or two of the following items of information—brake pipe pressure, steam heat pressure, direction of travel, and any interruption of current or other event (e.g. running past signal) that can be noted by an electro-magnet and stylus. The instrument also includes a six-digit mileage counter which can be used to show anything from trip mileage to mileage since overhaul.

The record of the trip is indicated by a ball-pointed stylus which marks directly on treated paper and which is not subject to wear. The chart itself is 102 mm. (4 in.) wide with the space for recording the speed 40 mm. (1⅝ in.) wide. The area below the speed record shows direction of running or current interruptions and the brake or steam line pressure. The area above the speed graph shows the time spent standing and the time spent under way.

Time is measured by a clockworks within the instrument which moves the chart 5 mm. per hour while standing and by the upper stylus which travels between the top and bottom lines of its section once every 10 minutes whether standing or running. The timing mechanism also controls the speed measurement by engaging and disengaging gears on a cycle exactly one second long, making the indication independent of temperature and friction.

■



Right Angle Pipe Support

A right angle pipe support, Ubolet type X, for use with standard pipe or rigid steel conduit for mounting on structural flanges up to ⅞ in. thick, has been designed by Spedon Pipe Clamp Company, Woodside 77, N.Y. The body is of heavy gauge pressed steel, hardened by a process combining a hard surface with a flexible inner core. Sharp biting edges at the corners provide self-equalizing bite pressure and better stability.

Bodies for pipe sizes of ¾ to 1 in. have interchangeable U-bolts and bodies for sizes 1¼ to 1½ in. can use either U-bolt. Available in ¾ to 2 in. pipe sizes.

(Turn to page 96)

Manufacturers' Literature

Following is a compilation of free literature, pamphlets and data sheets offered by manufacturers to the railroad industry. Circle the number(s) on the coupon below to receive the information desired; the requests will be sent direct by the manufacturers.

1. NICKEL ALLOYS. *The International Nickel Company, Inc.* 36-page booklet "Nickel Alloys in Railroad Equipment" illustrates and gives data on the use of alloys to meet needs in manufacturing: diesel-electric locomotives, electric locomotives, gas turbines, steam locomotives, passenger equipment, freight cars.

2. DISTRIBUTION TRANSFORMERS. *The Standard Transformer Co.* Descriptive bulletin S-302A gives data, prices, specifications and photos of OISC distribution transformers with built-in surge and overload protective devices.

3. LOCKNUTS AND COLLARS. *Standard Pressed Steel Company.* Two new 4-page bulletins on Flexlock Self-Locking Nuts (#866) and Hallowell Steel Shaft Collars (#868) describe, give specifications and typical applications of each. *Please specify.*

4. ELECTRICAL TAPES. *Minnesota Mining & Manufacturing Co.* 12-page, 2-color booklet "Scotch Electrical Tapes for Motor Construction and Repair" includes specifications for 10 different electrical tapes for a wide variety of insulation and holding applications in motor work.

5. V-BELTS. *Allis-Chalmers Mfg. Co.* Bulletin #20B7786 "High-Capacity 'Texrope' V-Belts" completely describes and pictures applications and advantages of the Texrope belts for tough jobs.

6. BAND SAWS. *Wells Manufacturing Corp.* 12-page, 2-color catalog "Wells Metal Cutting Band Saws" describes their complete line of horizontal metal cutting band saw machines, as well as special heavy-duty saws designed and produced for unusual cut-off jobs.

7. PLASTIC FOAM FOR INSULATION. *The Colton Chemical Co.* Illustrated, 8-page, 2-color booklet describes Colfoam, the new plastic foam for insulation, and suggests some of its practical applications which include refrigeration insulation for railroad cars.

8. FLAME CUTTING. *Air Reduction Sales Co.* 12-page booklet-reprint "Advanced Automatic Flame Cutting for Machinery Weldments" tells how to improve flame-cutting flexibility and increase production capacity while reducing the cost of flame-cut parts and steel plate items for these weldments.

9. RIGID-TEX METALS. *Rigidized Metals Corporation.* New 6-page, 2-color pocket sized folder explains Rigid-Tex Metals beauty qualities combined with its structural and functional properties, along with photographs of three-dimensional patterns, damage tests and typical applications.

10. VAPOR DEGREASERS, *Phillips Manufacturing Co.* 12-page, 3-color brochure "Phillips Vapor Degreasers" gives descriptions, illustrates various applications, and shows physical construction using cutaway drawings.

11. BATTERIES. *Exide Industrial Div. The Electric Storage Battery Co.* 14-page form 5010 newly revised maintenance manual on railway air conditioning and car lighting batteries, 3-hole punched, reflects the latest thinking on battery installation and maintenance, includes a discussion of thermostatic modulation of passenger car voltage regulators, and several charts.

12. INSULATED ELECTRICAL CABLE. *The Okonite Company.* 40-page booklet "Okonite Cables For Railroad Use" lists insulated electrical cable constructions for signal, communication, diesel electric locomotive and car wiring and portable cord and cable applications, gives complete dimensional data.

13. WELDING EQUIPMENT. *National Welding Equipment Co.* 36-page welding and flame cutting apparatus catalog (Form CW 19-5) "Outward Appearance Tells Little of Built-In Quality and Worth" lists all of the equipment the average user of welding and flame cutting apparatus will require. (Form PLCW-19 "Convenient Price List" sent if specifically requested.)

14. CLEANING MACHINES. *Magnus Chemical Company, Inc.* 8-page bulletin 704-AL "Metal Parts Batch Cleaning in Minutes" describes the Magnus Aja-Lif Cleaning Machines, discusses mechanical agitation in parts cleaning and shows different applications.

15. CAST BRONZE & COPPER PRODUCTS. *National Bearing Div. American Brake Shoe Co.* 24-page booklet #J-4515 "Cast Bronze and Copper Products for General Industry" deals with the firm's research, process, engineering and production facilities, offers an alloy chart, and presents performance characteristics and specific products uses of the alloys.

Reader Service Department — MAY, 1954
Railway Locomotives and Cars
30 Church Street, New York 7, N. Y.

Please send literature circled below:

1 2 3 4 5 6 7 8 9
10 11 12 13 14 15

Name ..... Title or Position .....

Company .....

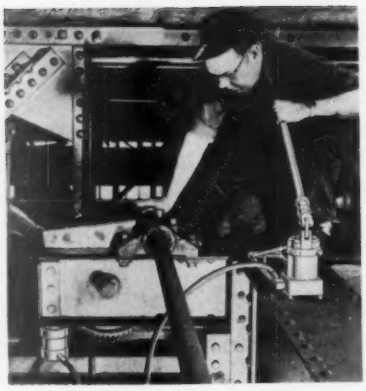
Address .....

City ..... Zone ..... State .....

NEW DEVICES

(Continued from page 95)

Hydraulically Operated Lifting Jack



The Lo-Hite Jack manufactured by the Duff-Norton Manufacturing Company, Pittsburgh, weighs 38-lb and can raise 30-ton weights.

The ram, which is separate from the pump, is attached to the pump through an 8-ft hose. The jack, which can be operated from the ground, stands only 6½ in at its highest and can be used in close-quarter lifting jobs. A typical application is in the lifting of trucks, etc., to replace worn bushings or wheels.

The unit can be used in both the vertical and horizontal positions since its oil is completely sealed in and completely isolated from the interior. It folds into a compact, easy-to-carry unit 4½ in high.

■

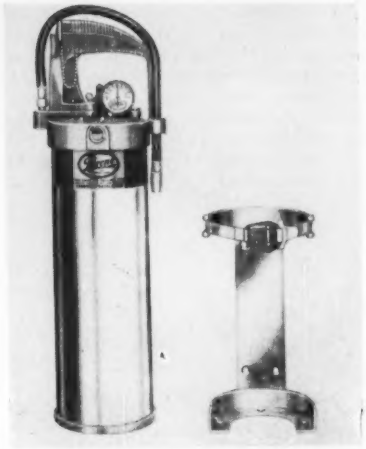
Sight Glass Liquid

A fluorochemical liquid for use in sight glasses of force-feed lubricators has been announced by the Minnesota Mining & Manufacturing Co., St. Paul 6, which reports that the liquid has a long useful life and will not become cloudy or leave deposits on the surface of the glass.

Called 101, the fluid is completely inert and, therefore, will not extract the additives in modern lubricating oils. It is colorless, odorless, non-inflammable and has no known effects on the body or skin.

It can be used in place of conventional glycerine or glycerine-water mixtures, eliminates the periodic removal for cleaning of sight glasses. The product is available in ½ pint, pint, quart and gallon quantities.

■



Pressure Vaporizing Fire Extinguisher

A 2-qt air-pressure vaporizing liquid fire extinguisher introduced by Pyrene Manufacturing Company, Newark 8, unit has a combination carrying handle and squeeze type operating valve balanced for easy manipulation.

The device can produce a 30-ft hose stream, said to be effective on Class C and B fires. It may be recharged by refilling with Pyrene liquil and pressurizing from a factory, garage or gasoline station air hose.

The liquid chamber is constructed of lightweight stainless steel. An inner chamber holds air under pressure. It has a liquid level glass port and air pressure gauge for visual inspection. A wall hook is supplied; a clamping bracket for vehicle mounting is optional.

(Continued on page 98)

NEW DEVICES

(Continued from page 96)

Bonded-Rubber Flexible Coupling

This flexible coupling is designed to transmit a torque of 200 in. lb. with a 7 deg. angular misalignment. The rated torque is transmitted in uninterrupted service. Motion in all directions is accomplished by its bonded-rubber members.

The coupling, made by the Lord Manufacturing Company, Erie, Pa., is manufactured with the elastomer securely bonded to the steel inner member of the individual joints. Arrangement of the coupling elements in series permits a soft torsional spring rate providing isolation of torsional vibration. Length of coupling can be changed to provide the required parallel misalignment.

■

High-Efficiency Fluorescent Light

General Electric, Nela Park, Cleveland 12, O., has unveiled a new type of fluorescent lamp which is said to produce 35 per cent more light than any previous fluorescent light source.

First of the new line is a standard cool white lamp, eight feet long and with a diameter of 1½ in. Rated at 110 watts, it has a total light output of 6,800 lumens. Its rated life is 7,500 burning hours.

An important feature of the lamp is a base of entirely new design. It incorporates two contacts recessed in a single element, and allows the lamp to be inserted easily and safely in push-pull lamp holders. Because of the new base, and because its operating characteristics differ from all previous types, the new lamp will be used only in new fluorescent lighting installations. The lamp employs the rapid start circuit.

A feature of the lamp is its ability to maintain its high light output even in cold weather, making it applicable to many out-of-door lighting jobs.

■

Steam Cleaning Material

Development of Composition No. 93, designed for use in steam-generating equipment and in steam guns where the solution is siphoned from an auxiliary tank, has been announced by Oakite Products, Inc., New York 6.

According to the manufacturer it is a

white, free-flowing powdered material which is soluble in water. Normal working concentrations range between ¼ and 4 oz per gallon of water, into which the formulation is sprinkled and stirred. Solutions are nontoxic and safe for steam gun operators to use since no offensive odors or unpleasant fumes are given off.

■

Switch Engine Recorder

This recorder, Model CC, provides a 24-hr. daily chart of time moving, time standing, speed and distance traveled. Visually, it shows speed, time and total mileage. The device is available from the Barco Manufacturing Co., Barrington, Ill.

A newly redesigned unit, its improvements include a restyled case and refinements in the operating mechanism. Record charts now have a rectangular center opening that automatically keeps the chart in correct position on the rotating hub of the instrument clock. The total mileage counter is now located in the top of the instrument directly over the speed indicator.

In conjunction with the recorder, the manufacturer is also introducing a drive unit for mounting on a wheel axle journal box cover. This device is designed to withstand heavy duty switch engine service.

■

Wet Blast Cleaning

Parts like pistons, valves and rods often need to be freed of carbonaceous scale, rust and other surface contaminants to avoid plugging up. Cleaning problems are often difficult because many of these parts are built to close tolerances.

In an effort to decrease maintenance costs and speed processes, the American Wheelabrator & Equipment Corporation, Mishawaka, Ind., has developed a wet blasting process through a unit designated as the Liquamatte. The process consists of throwing water-suspended abrasives at the work by compressed air.

Cleaning is said to be rapidly accomplished and all areas of a part receive the same uniform finish. Grinding lines, surface scratches and other defects are completely blended out. Surface abrasion is easily controlled since fine mesh abrasives such as 325 or 140 mesh are employed. Dimensions can be held to 0.0001 in. when required.

■

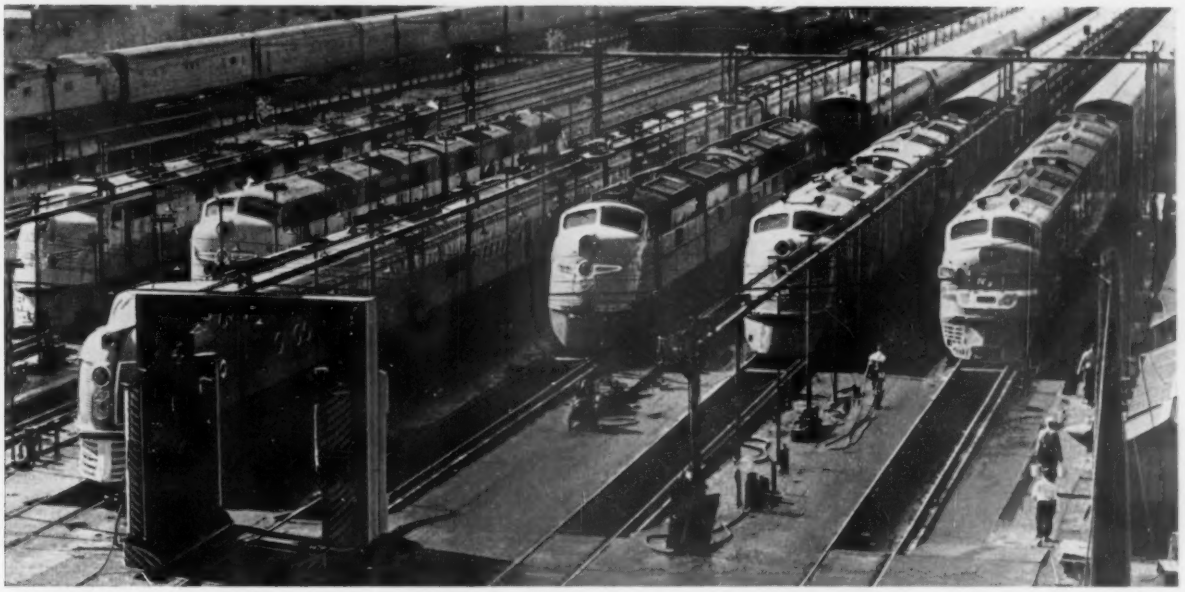
Rust-Arresting Fish Oil Paint

A rust-arresting line of metal coatings, employing an odorless fish oil base, that may be applied directly to rusted surfaces with

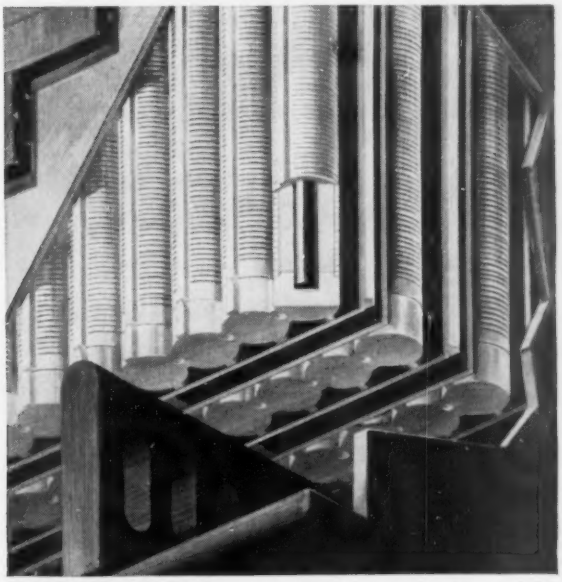
(Continued on page 102)

GET UNINTERRUPTED "ON LINE" SERVICE

. . . with low cost Exide-Ironclad diesel batteries!



WHEN DIESELS are equipped with Exide-Ironclad batteries you are assured high availability of equipment—uninterrupted "on line" service. These ruggedly built batteries assure quick starting and the positive operation of control equipment because they have ample reserve power at high sustained voltage. In addition, lower costs for operation, maintenance and depreciation make Exide-Ironclad diesel batteries your best power buy—AT ANY PRICE!



THE POSITIVE PLATES are the heart of any battery. Only Exide uses a slotted tube construction. By use of tubes, more active material is exposed to the electrolyte, providing *greater power*. Also, more active material is retained, giving *longer working life*.

DEPENDABLE POWER, ample reserve power for any diesel need, comes from improved Exide-Ironclads. Prompt delivery. For full details, call your Exide sales engineer—write for Form 4843 (Installation and Maintenance of Diesel Starting Batteries).

Your best power buy
. . . AT ANY PRICE!

Exide®
IRONCLAD® BATTERIES

Exide **INDUSTRIAL DIVISION,** The Electric Storage Battery Company, Philadelphia 2, Pa. • *Exide Batteries of Canada, Limited, Toronto*

NEW DEVICES

(Continued from page 99)

a minumum of preparation has been produced by Rust-Sele Company, Cleveland.

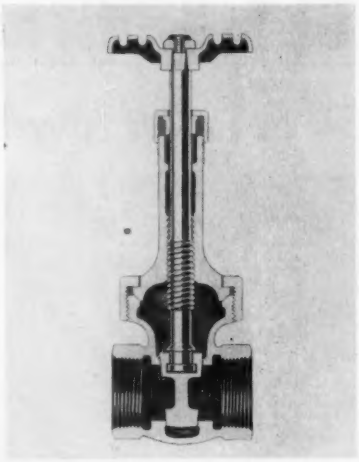
The preparation known as Rust-Sele was developed in two basic types, long-oil coatings for exterior use, and short-oil coatings for interior service. The long-oil coating is recommended for exposed piping systems, industrial projects, towers, etc. It affords a protective coating that resists rain, snow, sun and extreme temperatures. The other formulation is recommended for interiors and in sheltered exteriors where extreme rust conditions are found.

Both coatings are available in 24 colors, including white, aluminum and black. It is packed in 1- and 5-gal cans, and up to 55-gal drums.

■

Bronze Valves

A line of bronze globe, angle, and gate valves, equipped with Coradur stems to overcome effects of corrosion and dezincification, has been announced by the R-P&C



Division, American Chain & Cable Company, Reading, Pa.

This stem, composed of 91 per cent copper, 7 per cent aluminum, and 2 per cent silicon, is reported as 10 per cent lighter than naval brass and offers a high tensile strength of over 95,000 lb. per sq. in. The manufacturer claims that the alloy has a low coefficient of friction to give longer stem wearing threads and bonnet threads.

■

Hook-On Volt-Ammeter

A new hook-on volt-ammeter with automatic scale changing has been announced by the General Electric Company's Meter and Instrument Department, Schenectady 5, N. Y.

Designated the AK-5, the pocket-size unit is designed to measure current and voltage quickly and accurately. Its automatic scale changing feature is said to eliminate the possibility of reading the wrong scale for the application.

It has a current range of 5/20/80/350 amp., embracing the extent of currents normally encountered in industrial and commercial circuits.

The five-amp range permits load checks on fractional-horsepower as well as low-energy control circuits.

The instrument also measures a-c voltage in three ranges (150/300/750) without auxiliary equipment, provides accuracy up

to three per cent of full scale, and withstands a voltage breakdown test of 4,000 volts a-c.

The instrument will clamp around any conductor up to two in. in diameter. Its contoured trigger closes and opens the hook-on assembly, which is covered with insulation to help safeguard against grounding or short-circuiting. The desired range and scale is obtained by turning the unit's switch knob. Current scales are marked in black; voltage scales in red for easy reading.

The device is shock-resistant and is provided with screw-in voltage leads. It weighs 1¼ lb and measures 9⅛ x 3 7/16 x 1 9/16 in.

■

Light Weight Dust Hood

This dust hood has been designed to protect eyes, head, nose, face and neck from nuisance or irritating dusts. Manufactured by the General Scientific Equipment Company, 1017 Packard bldg., Philadelphia 32, it weighs only 5 oz. making it easy to wear. The maker designates it the No. 1 Hood.

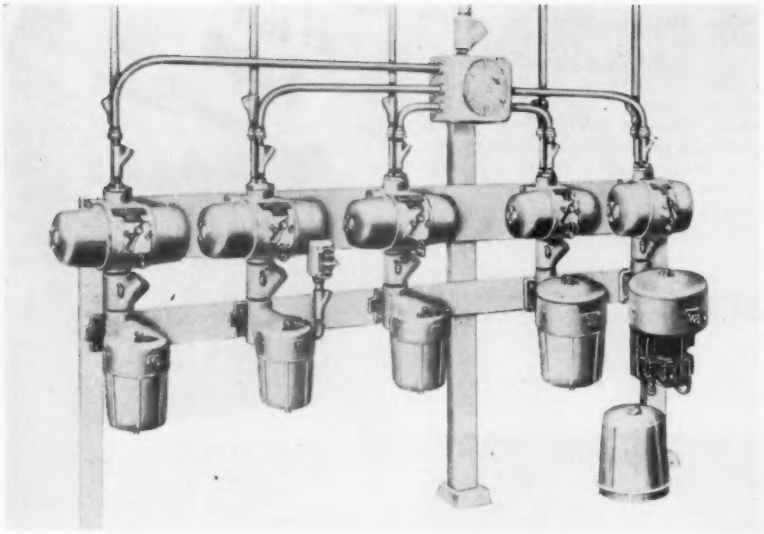
Made of light weight cloth, with a large picture window, the hood offers unrestricted visibility in all directions. It may be worn with a respirator.

■

Outdoor Type Circuit Breakers

A complete new line of explosion-proof, dust-tight, rain-tight circuit breaker, motor starter, and line starter combination enclosures has been announced by the Appleton Electric Company, Chicago. The enclosures (trade name Appleton Unilets) carry U.L. (Underwriters Laboratories) approval, and with a new sealing Unilet,

(Continued on page 104)



may be joined in combination to meet U.L. requirements in certain sizes.

Each component Unilet for circuit breaker, motor starter, and seal possesses full seven-thread engagement at the coupling joints as well as on the bolt-free covers. Safe entrance to individual motor starters for maintenance work is assured in both single and banked combinations in hazardous areas without shutting off other branch circuits. No live circuit breaker wires are exposed while the motor starter enclosure is open on a line starter combination.

Other features include U.L. approval on banked circuit breaker Unilets up to groups of three for Forms 1 and 2; lightweight construction for easy installation without use of heavy lift equipment; standardized mounting for interchangeability of most well-known makes of circuit breakers and motor starters in certain sizes; simplified straight-through wiring; hub adaptors which permit use of over-size conduit and conductors; and streamlined push-button and pilot-duty control.

The line covers all breaker-starter control equipment of leading firms rated to 225-amp. breaker loads and to 100 hp. on three-phase induction motors at 600 volts maximum.

■

Snap-Around, Volt-Ammeter

Three high-voltage models have just been added to the Amprobe Junior Line of pocket volt-amp. testers made by the Pyramid Instrument Corporation, Lynbrook, N. Y.

Each comes with two voltage ranges: 0-150/600 volts a.c. and is available in an ammeter range of either 0-25, 0-50 or 0-100 amp. a.c. These three models are especially designed to fill the needs of the plant maintenance man, plant electrician and industrial contactor.

For electricians, contractors and service men who work mostly with 110-volt and 220-volt lines, the instruments are also available in 0-125/150-volt models, in current ranges of 0-10, 0-25, 0-50 or 0-100 amp. Accuracy is plus or minus 3 per cent.

■

Vinyl Upholstery

For use in transportation seating a new porous upholstery designated Breathable Naugahyde has been perfected by the United States Rubber Company, Mishawaka, Ind. It is claimed to assure complete seating comfort when used over foam rubber cushioning or deep springs.

The upholstery is now being made in four colors; torquoise, grey, dark green and maroon and can be made in a variety of colors, textures and patterns. It is 54

in. wide and is sold in 30 yd. rolls. It has a strong cotton fabric backing. The product has a slip finish, is easy to maintain since it won't absorb dust and can be cleaned with a damp cloth.

■

Reflector Lamps

Narrow and wide beam 300-watt reflector lamps with a PAR-56 bulb shape are available from the Westinghouse Electric Corporation, East Pittsburgh, Pa. Rated for an average life of 2,000 hr., these lamps may be used at 115, 120, or 125 volts and may be burned in any position.

A powerful and accurately controlled beam is the important characteristic of these new lamps. They also offer freedom from fixture maintenance.

The base is a mogul end prong type, to be used for the purpose of electrical connection only and not for supporting the lamp. Although made of heat-resisting glass, the bulb may break on contact with water. Therefore, it should be used with equipment which protects it from the weather. This equipment should be so designed that the operating temperature of the connector plug wiring does not exceed 200 deg. C.

■

Terminal Blocks

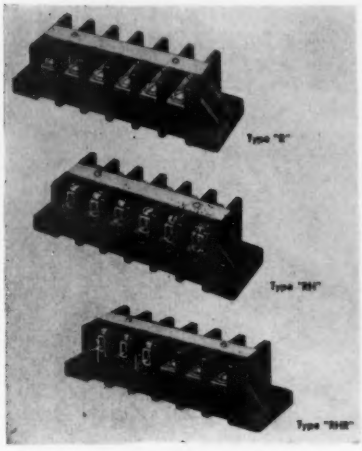
High-current terminal blocks, known as the Series R, are being placed on the market by the Curtis Development & Manufacturing Company, Milwaukee, Wis. The new series will be available in three types, namely: Type R, rated 35 amp., 750 volts with No. 10 brass washerhead terminal screws for wire up to No. 10 A.W.G.; Type RH, rated 50 amp., 750 volts with high-pressure solderless connectors for wire from No. 8 to No. 18 A.W.G.; and Type RHR, consisting of any combination of types R and RH in the same block.

It is said that the series features interchangeability with other standard high-current blocks on the market. Blocks measure 1⅞-in. wide, with terminals

(Continued on page 107)

NEW DEVICES

(Continued from page 105)



spaced on standard ¾-in. centers. Also featured are the universal three-hole mounting brackets integrally molded with end partitions to provide such design advantages as elimination of the conventional assembly stud to increase length of creepage path to ground, maximum accessibility of the central mounting hole; elimination of corrosion problems, and ample mechanical strength. The center mounting hole is an added advantage for convenient one-screw mounting of smaller blocks. Copper terminals are satin-nickel finished. A white marker strip is provided for convenient circuit identification.

■

Cable Splice Tape

Introduced several years ago to the communications field, "CSI Cable Splice" rubber tape made by CSI Sales Company, Solon, Ohio, is now available, through increased production for industrial, commercial and transportation use.

Among important features, claimed for the tape, are its imperviousness to copper; 19,000-volt dielectric strength; and its acid resistance and anticorrosive effect.

The tape has cohesive properties which make it possible to apply the tape lengthwise by pinching. Splice jobs which can be handled without winding, save both time and material. It has an elongation factor of 600 per cent and a tensile strength of 19 lb.per inch width. It is packaged in ¾-in. and 2-in., 15-ft. rolls.

■

High-Heat Aluminum Paint

Thermalite, a high-heat aluminum paint has been developed for use on metal surfaces with temperatures ranging from 400 to 1000 deg. F. The paint can be used on diesels to finish manifolds, exhaust stacks and other areas where high heat is a problem.

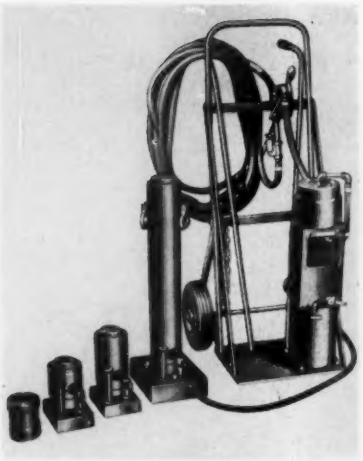
Formulated with a heavy silicone content, it is made by the Tropical Paint & Oil Company, Cleveland 2. The product will not discolor, blister, flake or burn off according to the manufacturer and is available in both interior and exterior formulations.

■

Air Hydraulic Jack

A hydraulic jack, incorporating the use of 80 to 100 lb. compressed air to provide operation of a separate pump, has been introduced for heavy-duty maintenance

(Continued on page 108)



work by the Duff-Norton Manufacturing Company, Pittsburgh, Pa.

This combination jack and ram consists of a choice of four hydraulic rams in lengths of 4½, 7½, 10 and 28 in. They can move a 30 ton load in any direction or distance of 2, 3½, 6 and 20 in. respectively.

Its air motor is mounted on a portable buggy and comes complete with 50 ft. of ½ in. air hose and 6 ft. of flexible hydraulic hose.

■

Vestibule Curtain Release

A new Type B-J vestibule curtain release handle is being offered by the Morton Manufacturing Company, Chicago. The distinctive feature of this new handle is that it automatically releases at the correct tension point of approximately 25 lb. It is simple in design and weighs but 1 lb.

Handles of this type have been in service for over a year and reports indicate that the positive release feature prevents torn curtains in switching operations.

■

Silicone Enameled Magnet Wire

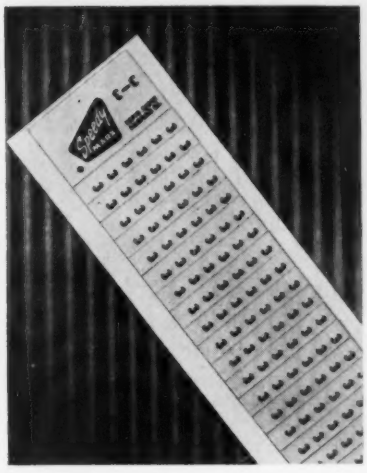
Intended for use in electrical equipment operating at hottest spot temperatures of at least 130-deg Centigrade, a new silicone enameled magnet wire has been produced by Anaconda Wire & Cable Co., Muskegon, Mich.

The wire has good abrasion resistance, adheres well to the conductor, is smooth, tough and is not attacked by common solvents. The enamel will not crack when exposed to solvents, and will not crack when subjected to temperatures as low as —65 deg. C.

Dielectric strength of the new product is 1,500 volts per mil. Best results in windings are obtained by using silicone treated fiberglas insulators and silicone varnishes.

Wires insulated with the new enamel are furnished in single and heavy grades, in dimensions as given in Anaconda's General Catalog for Formvar and nylon. The film is easily removed by chemical strippers such as those used for Formvar, or by wire brushes.

■



High-Temperature Wire Markers

The North Shore Nameplate Company, Glenwood Landing, L. I., N. Y., are now making an indentification band for electrical circuit conductors called Speedy-Marx Hi-Temp Wire Markers, which are capable of resisting temperatures up to 400 deg. F.

The special pressure sensitive tape used to make the markers is also not affected by cold and high humidity, and may be applied to flat surfaces as well as wires.

The markers are made in standard Speedy-Marx codes or can be made to customers' specifications.

■

Dry Chemical Fire Extinguishers

Pressurized dry chemical fire extinguishers, designated as Models PDC-5, 10, 20, and 30 to indicate the capacities by weight of the chemical, have been introduced by American-La France-Foamite Corporation, Elmira, N. Y.

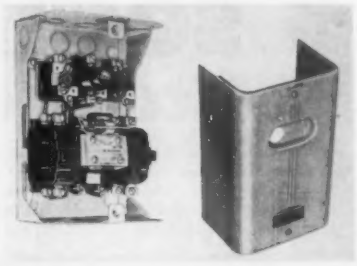
The manufacturer claims that these units are ready to stop a fire immediately, simply pull a pin and squeeze the lever. Fire-smothering efficiency is aided by the discharge nozzle which fans the dry chemical outward and downward in a wide pattern with great density. Their 150 (plus 25, minus 0) lb. per sq. in. air or nitrogen pressure maintains this pattern. When partially operated, they can be left standing without loss of air pressure.

These units are approved by Underwriters' Laboratories for Class B and C fires.

Three-Coil Motor Protection

Three-coil rather than two-coil motor protection is recommended and now provided for by Cutler-Hammer, Inc., Milwaukee, Wis. The reason for this development is that on wye-delta systems for example, an open phase in the primary of the transformer results in one high and two low currents. If only two lines are protected, the chances are one in three that the high current line will be the unprotected one.

The Cutler-Hammer starter illustrated offers three-coil overload protection in the same enclosure at little extra cost. An additional feature of Cutler-Hammer three-coil starters is an adjustable heater coil. This provides four different ratings from a single coil by changing its position.



—ADVERTISERS IN THIS ISSUE—

These and many others depend on Esso Railroad Products

High quality Esso Railroad fuels and lubricants are being used in more and more railroad diesels for smooth, powerful performance... long, trouble-free service.

Toughest tests ... on the road and in the lab insure that Esso Railroad Products meet and surpass the most rigid requirements set by the fast pace of modern railroading.

Continuous follow-up ... and on-the-job service by Esso Sales Engineers assure the top performance and dependability of the complete line of Esso Railroad fuels and lubricants.

ESSO

RAILROAD PRODUCTS

Like *All* Esso Railroad Products These Assure You Dependable Performance

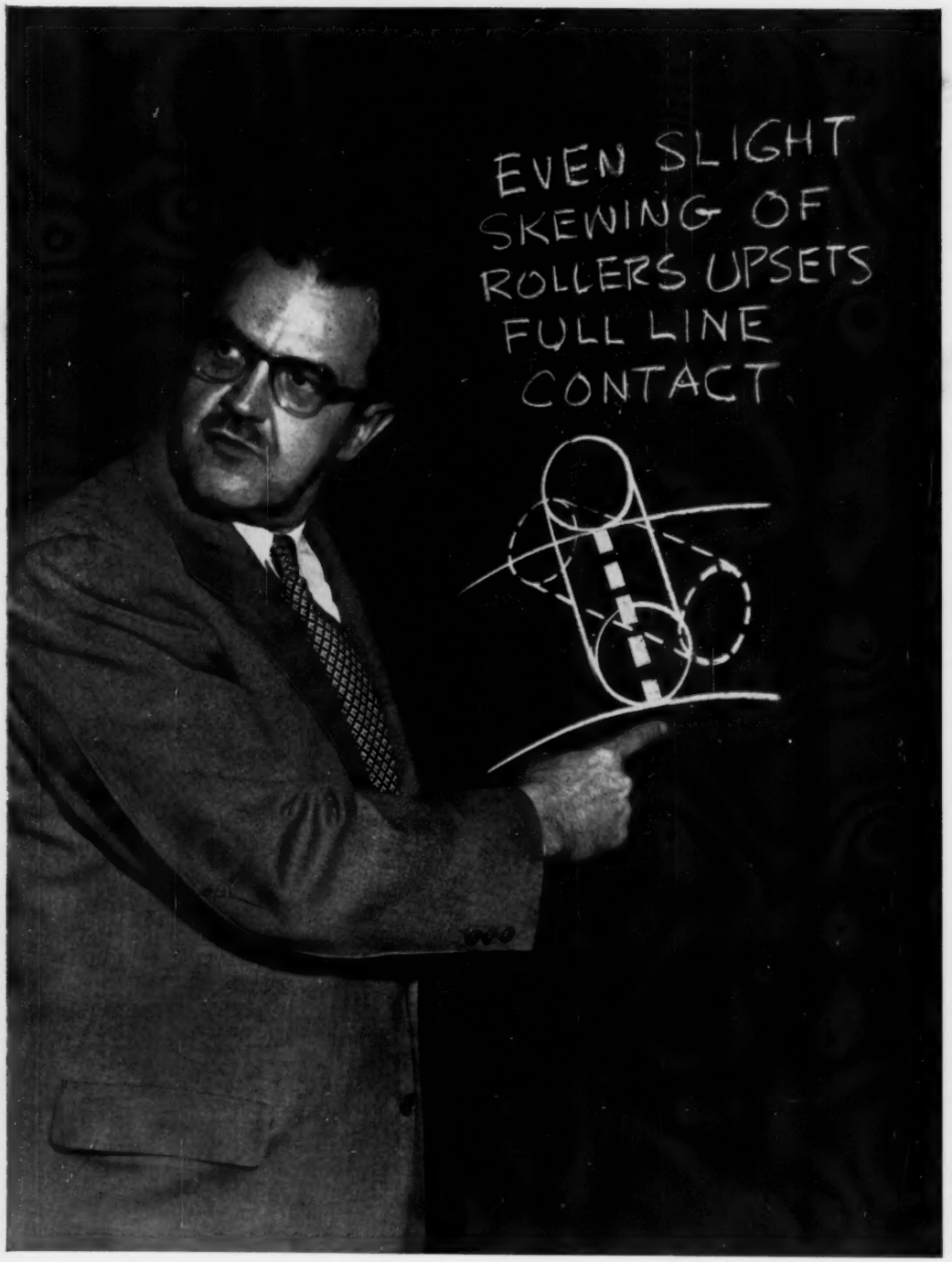
Diesel Fuels
ESSO ANDOK Lubricants—versatile greases
ARACAR—journal box oils
ARAPEN—brake cylinder lubricant
ESSO XP Compound—hypoid gear lubricant
DIOL RD—Diesel lube oil
COBLAX—traction motor gear lube
VARSOL—Stoddard Solvent
SOLVESSO—Aromatic solvent
ESSO Weed Killer
ESSO Hot Box Compound
AROX—pneumatic tool lube
CYLESSO—valve oil
ESSO Journal box compound
Asphalt
Cutting Oils
Rail Joint Compounds
Maintenance of Way Products
Signal Department Products

SOLD IN: Maine, N. H., Vt., Mass., R. I., Conn., N. Y., N. J., Pa., Del., Md., D. C., Va., W. Va., N. C., S. C., Tenn., Ark., La.

ESSO STANDARD OIL COMPANY — Boston, Mass. — New York, N. Y. — Elizabeth, N. J. — Philadelphia, Pa.—Baltimore, Md.—Richmond, Va. — Charlotte, N. C. — Columbia, S. C. — Memphis, Tenn. — New Orleans, La.

This month Dr. Oscar Horger demonstrates that full line contact is one reason why:

The taper makes TIMKEN® the only journal bearing that delivers what you expect when you buy a roller bearing



ROLLER bearings are used on ra road journals for two prima reasons—to end the hot box probl and cut operating and maintenar costs to a minimum. The Timke tapered roller bearing is the *one* be ing you can be sure of to do this. I the taper! Here's why:

1) *Positive roller alignment.* The tap holds ends of rollers snug against t rib, where wide area contact kee rollers properly aligned. There's skewing of rollers to upset the full li contact and shorten the life of t bearing. The load is always carri over the *full* length of the rollers.

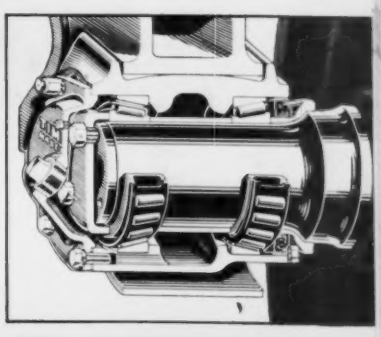
2) *No lateral movement within the be ing.* In straight roller bearings, late movement causes scuffing of roll and races, especially on freight c when they're dumped or bump while standing still.

Lateral movement pumps lubrica through the seal and out of the jourt box, draws dirt and water in.

Lateral movement also makes it nec sary to use extra thrust bearings, bloc or other devices to take thrust loa These thrust devices are not comple ly effective, are hard to lubricate wi grease, and increase maintenance.

The taper in Timken bearings pr vents lateral movement, enables the to take the thrust. There's no scuffin no pumping action. This helps end t hot box problem, means less mai tenance, less lubricant and long bearing life.

Get what you pay for when you swit to roller bearings to end the hot b problem and cut operating and mai tenance costs to a minimum. Get Timk *tapered* roller bearings. The Timk Roller Bearing Company, Canton Ohio. Cable address: "TIMROSCO



THE TAPER MAKES **TIMKEN** THE BEARING YOU TRUST

NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ◫ AND THRUST →◫← LOADS OR ANY COMBINATION ✳